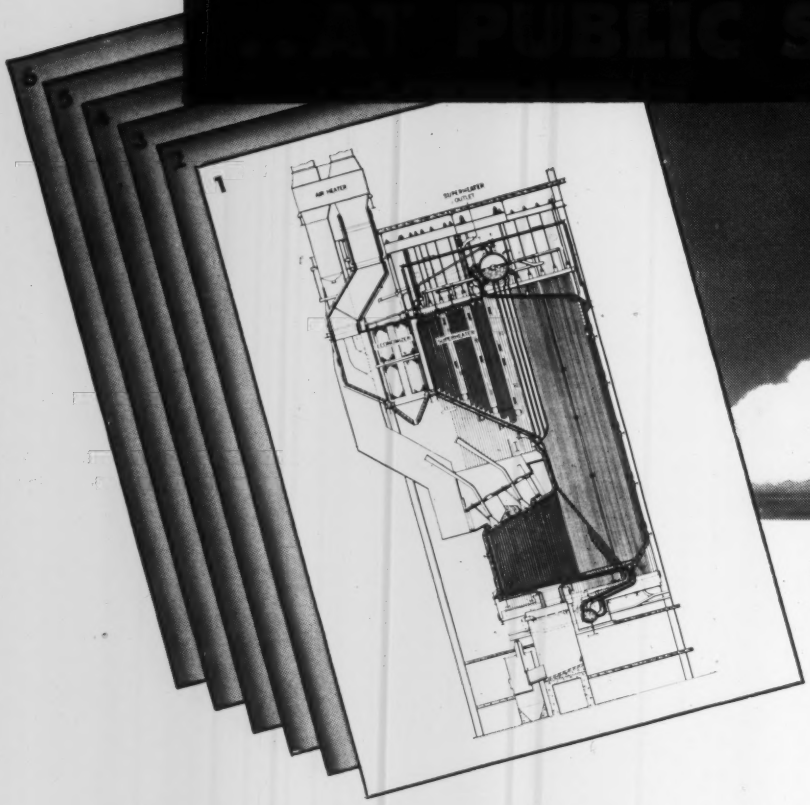
AUG 7 1945

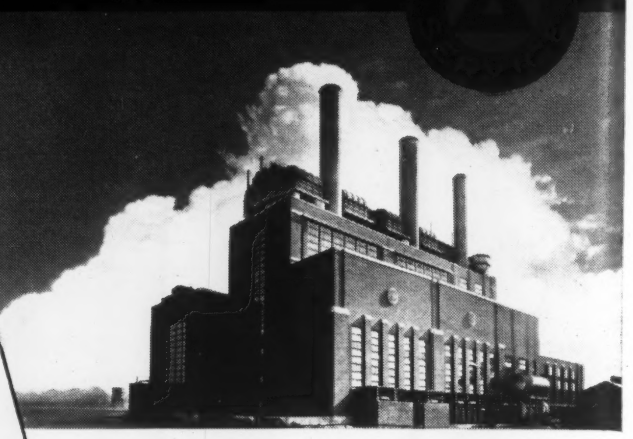
MECHANICAL ENGINEERING

AUGUST 1945

NEERING
BRARY

[illegible] EXTRA SERVICE [illegible] PUBLIC SERVICE





Burlington Generating Station where four B&W Radiant Boilers are supplying over 2,000,000 pounds of steam per hour.

Six B&W 550,000 lb. per hour Radiant Boilers of this design are performing notably at Burlington and Marion Generating Stations of Public Service Electric and Gas Company.

In New Jersey's critical war-plant areas, with their enormously increased load demands, power has never been "too little or too late." To the Electric Department of Public Service Electric and Gas Company belongs much credit for this distinguished war-time record. Its keen foresight and sound engineering in providing power-plant facilities capable of supplying war-urgent demands far beyond expectations are well illustrated by the performance of the Burlington and Marion Generating Stations.

In these two stations six Babcock & Wilcox Radiant boilers serve three 125,000-kw turbines, the first two boilers having been in service over 4½ years. Operating at their maximum guaranteed continuous rating most of the time, the load factor for the six boilers has averaged 81.6 per cent, and the availability factory 90.6 per cent, for a total of twenty boiler years.

These boilers have never suffered a decrease in capacity caused by slag troubles, even though they have burned low ash-fusion coals from three states and *many* different mines—coals entirely different from the normal supply.

Public Service engineers knew—as do so many other power engineers—that with the selection of B&W steam-generating equipment, all the advantages are realized from over 60 years' specialized experience in designing, fabricating, and applying boilers and related equipment having a long record of highly satisfactory service.

Thinking and planning for tomorrow *today* is a job that B&W engineers are ready to tackle—in partnership with your engineers—at any time.

B&W

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.

85 LIBERTY STREET • NEW YORK 6, N. Y.

MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 67 NUMBER 8

Contents for August, 1945

THE COVER . . . . . *Marsh Buggy in Operation in Deep Water*
THE GULF MARSH BUGGY . . . . . *E. W. Jacobson* 501
A REPLY FROM INDUSTRY TO THE COLLEGES . . . . . *M. M. Boring, A. R. Stevenson, Jr., and K. B. McEachron, Jr.* 504
RADIAL RAKE ANGLES IN FACE MILLING—3 . . . *J. B. Armitage and A. O. Schmidt* 507
LOAD-COMPENSATING AIR BRAKES . . . . . *C. D. Stewart* 511
FEEDWATER TREATMENT FOR LOCOMOTIVE USE . . . . . *T. W. Hislop* 515
DEVELOPMENTS IN THE FREIGHT-CAR TRUCK . . . . . *R. B. Cottrell* 517
PATHS TO SMOKE ABATEMENT . . . . . *R. A. Sherman* 520
AN ANALYTICAL METHOD OF CAM DESIGN . . . . *W. B. Carver and B. E. Quinn* 523
"OPERATION PLUTO" 527
LABRAM AND THE "LONG CECIL" . . . . . *C. E. Davies* 530

EDITORIALS 499
COMMENTS ON PAPERS 533
REVIEWS OF BOOKS 537
A.S.M.E. BOILER CODE 538
A.S.M.E. NEWS 539
A.S.M.E. CANDIDATES FOR OFFICE, 1946 551
CONTENTS OF A.S.M.E. TRANSACTIONS . . 564

INDEX TO ADVERTISERS 144

OFFICERS OF THE SOCIETY:

ALEX D. BAILEY, *President*

K. W. JAPPE, *Treasurer* C. E. DAVIES, *Secretary*

PUBLICATIONS STAFF:

GEORGE A. STETSON, *Editor* FREDERICK LASK, *Advertising Mgr.*

K. W. CLENDINNING, *Managing Editor*

COMMITTEE ON PUBLICATIONS:

E. J. KATES, *Chairman*

L. N. ROWLEY, JR. H. L. DRYDEN

W. A. CARTER J. M. JURAN

ADVISORY MEMBERS OF THE COMMITTEE ON PUBLICATIONS:

N. C. EBAUGH, GAINESVILLE, FLA. HUNTER R. HUGHES, JR., DALLAS, TEXAS O. B. SCHIER, 2ND, NEW YORK, N. Y.

Junior Members: RICHARD S. BIDDLE, NEW YORK, N. Y.; JOSEPH M. SEXTON, NEW YORK, N. Y.

Published monthly by The American Society of Mechanical Engineers. Publication office at 20th and Northampton Streets, Easton, Pa. Editorial and Advertising departments at the headquarters of the Society, 29 West Thirty-Ninth Street, New York 18, N. Y. Cable address, "Dynamic," New York. Price 75 cents a copy, $6.00 a year; to members and affiliates, 50 cents a copy, $4.00 a year. Postage outside of the United States of America, $1.50 additional. Changes of address must be received at Society headquarters two weeks before they are to be effective on the mailing list. Please send old as well as new address. . . . By-Law: The Society shall not be responsible for statements or opinions advanced in papers or . . . printed in its publications (B13, Par. 4). . . . Entered as second-class matter at the Post Office at Easton, Pa., under the Act of March 3, 1879. . . . Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on January 17, 1921. . . . Copyrighted, 1945, by The American Society of Mechanical Engineers. Member of the Audit Bureau of Circulations. Reprints from this publication may be made on condition that full credit be given MECHANICAL ENGINEERING and the author, and that date of publication be stated.

Courtesy The Babcock and Wilcox Company

One of Two 90-Ton Boiler Drums Being Installed at the Hell Gate Plant, The Consolidated Edison Company of New York, Inc.

VOLUME 67
No. 8

MECHANICAL ENGINEERING

AUGUST
1945

GEORGE A. STETSON, *Editor*

An Improved Catalog

THE Cooper Union School of Engineering has just issued what appears to be a new type of college catalog. It contains about all the information that a prospective student may need to know in making his choice, but it does so in a manner which keeps the needs of the student constantly in mind. The catalog is intended to be read and is readable. It is divided into three sections, "The Candidate Decides," "The Candidate Applies," and "The Candidate Is Admitted."

In the first section an attempt is made to help the candidate decide whether or not he should study engineering. This is, in many ways, the most significant section of the catalog. What an engineer does and what qualifications and education he must have for success are not well understood by laymen or by many young men preparing for their careers. It is important to screen out at the start the misfits who possess aptitudes and qualifications for careers in industry but not in those sectors of it which are the engineer's province. Because thousands of young men have been forced by the war into work which involves machinery, electrical devices and equipment, and the use of tools and instruments, many veterans will be returned to civil life with the mistaken impression that they should become engineers when their aptitudes and talents are better suited to, and they themselves would find greater success and satisfaction in, jobs performed by skilled artisans or technicians. In simple language the Cooper Union catalog, in this first section, makes it clear that the artisan, the technician, and the engineer perform different and distinctive tasks and that each of these three kinds of careers demands its own characteristics for success. If a high-school boy or a returning veteran is led by reading this catalog into the line of work for which he is best suited, both he and society in general will benefit.

By the time a young man has finished a thoughtful reading of the catalog he should be able to judge intelligently for himself whether or not he should undertake to make a career in engineering, what qualifications he must have for success in that career and in preparation for it, and what The Cooper Union has to offer him and expects of him if he is admitted.

Industry's Influence

ASIDE from the engineering schools and their students no group of persons has a greater concern for the education of engineers than the engineering firms and manufacturing establishments who employ engineering graduates. Representatives of these employers, who are, in most cases, themselves engineers, are prominent in activities that have the welfare of young engineers at heart. They serve on committees of the engineering societies; they form a powerful segment of influence in the Engineers' Council for Professional Development; they act on advisory and alumni boards; they are members of boards of trustees of engineering colleges; many of them are lecturers at these institutions, or teach in extension courses and evening schools; they will be found on boards of education and doing guidance work with high-school students; they offer opportunities for engineering teachers to get practical experience during vacation periods or by part-time arrangements; and some of them are engaged in teaching advanced engineering to graduate engineers-in-training. From many points of view these men and the companies they represent are an essential part of the educational system although not formally a part of it.

One of the characteristics of the relationship which has grown up between engineering teachers and engineering practitioners is the attitude of mutual respect which experts in one field should have for experts in another. It is a tribute to both sectors of the engineering profession that this attitude of respect, based on honest attempts at understanding the other fellow and his problems, a tolerance of opinion which is typical of engineers, and a realization that both groups are engaged fundamentally in different aspects of the same task of building a powerful, intelligent, socially useful, and unified profession, has been growing rapidly during recent decades. Only a few generations ago a young man sought to conceal the fact that he was a college graduate; today his engineering college degree is his principal asset.

To a large extent the engineering societies themselves are responsible for the change in the attitude of employers toward engineering graduates. From the start most engineering societies have been influenced by superior men in education and in the profession who have worked together and have tried to understand each other's problems. As a result the engineering schools have tried to give the kind of education that would be most useful to graduates and employers, and employers, today mostly engineering graduates themselves, have tested the product and have determined, in many cases more wisely than the teachers themselves, what curricula and educational policies are best. There still exist employers who expect to hire men for engineering posts who are skilled technicians ready to perform specific tasks in a narrow field and there are still educators who hold this type of training to be necessary and ideal. But if there is any trend of educational policy significant of the best thinking of both educators and employers, it is the policy which emphasizes fundamentals, breadth, and depth in the educational experience.

Evidence of the validity of the foregoing assertions

may be found in the article, "A Reply From Industry to the Colleges," which appears in this issue. The authors are engineers in industry, but their work and interests are closely related to education. The article would be useful and significant at any time, but present conditions enhance its value. The war has accelerated many developments to a point where they command almost universal interest and where there exists a temptation for the schools to forget the ideal of emphasis on fundamentals and seek to train specialists in aeronautics and electronics, to mention but two examples. The war has also interrupted educational programs and has introduced a temporary necessity for highly specialized training at the expense of breadth and fundamentals. In wartime courses there has been no time for those humanistic studies that are essential for the development of a full intellectual habit of mind required for good citizenship and industrial leadership. The reassembly of depleted and dispersed faculties and the rebuilding of curricula based on sound educational policies will be a task for the next generation. To this task engineering teachers and engineers in industry, working through all the agencies at their disposal, must combine their efforts if they expect to create a profession which has unity and stature and commands public confidence and respect.

The Metric System

REFERENCE to publications of The American Society of Mechanical Engineers will disclose the fact that the Society has, from its beginning, exhibited a lively interest in the controversy which flares up frequently over the relative merits of the so-called English and the metric, French, or decimal systems of weights and measures. At the first Annual Meeting of the Society, held Nov. 4 and 5, 1880, Coleman Sellers presented a paper, "The Metric System—Is It Wise to Introduce It Into Our Machine Shops?" Mr. Sellers' answer to this question was a strongly emphasized, "No," and in his conclusion members who discussed the paper concurred.

In 1897 George W. Colles presented a paper, "The Metric Versus the Duodecimal System," which, with discussion, ran into 120 pages. He confessed that he had originally been favorably disposed toward the metric system as it had always been represented to him "that no one whose opinion was worth having looked upon the metric system as anything other than a universal boon." However, when the English philosopher Herbert Spencer decried the further spread of the metric system, Mr. Colles made a thorough study of it, the results of which are embodied in his paper, and presented 24 conclusions definitely opposed to it. In discussing the paper William Kent suggested that the paper "be printed and reprinted for the next ten or twenty years and put into the hands of every congressman and senator. If any congressman studies this paper he will never then try to pass a compulsory law in favor of the metric system."

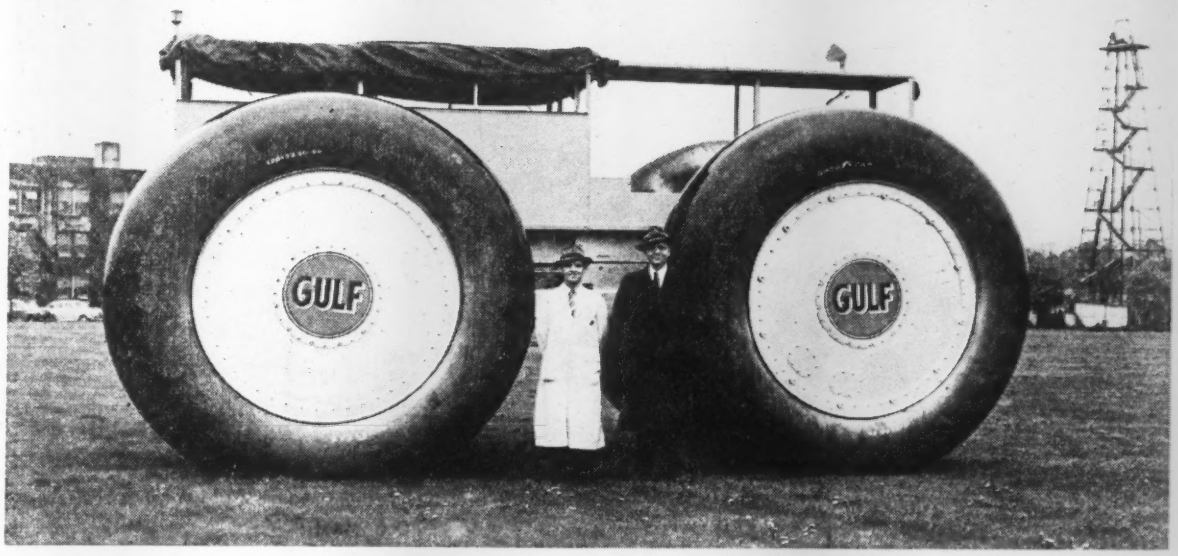
In 1903 the introduction into the Congress of a bill which would have made the universal use of the metric system compulsory resulted in two papers that appeared in the Transactions of that year, "A Rational Solution of the Problem of Weights and Measures," by Sidney A. Reeve, and "The Metric System," by F. A. Halsey. The author of the first of these papers expressed the opinion "that to commit ourselves finally to its [the metric system's] universal, compulsory adoption would be a mistake of immeasurable magnitude." In the vigorous language for which he was well known Mr. Halsey said, "I shall show that our foreign customers do not care one picayune whether we adopt it [the metric system] or not, and I shall prove it by a flood of evidence." Some 70 pages are devoted to this "flood," and another 162 record the discussion the paper provoked. In 1919 Mr. Halsey returned to this subject in a paper, "Weights and Measures of Latin America."

In the 1903 volume a brief report of the committee appointed to discuss the arguments in favor of and against the metric system states the opinion that "legislation designed to compel the exclusive use of the metric system is undesirable." Following this report are two sections, printed on facing pages, devoted to (1) the prometric argument and the antimetric reply, and (2) the antimetric argument with the prometric reply. Twenty-three appendixes complete the report, the last of which bears the title, "What Is the Use of Further Argument by the Metric Advocates?" At the Saratoga Meeting of the Society in June, 1903, the results of a letter ballot of member opinion on the metric system were reported. Of the members voting, 80 per cent were opposed to the adoption of the metric system as the only legal standard in the United States.

An argument for the creation of a technical commission "to study and report on the whole question of our weights and measures, its conclusions to form a foundation for action by the National Legislature," was advanced by Henry R. Towne in 1906 in a paper, "Our Present Weights and Measures and the Metric System." Discussion of this paper indicated that few members favored creation of the proposed commission.

These few examples are sufficient to show that mechanical engineers have periodically examined the arguments for and against compulsory adoption of the metric system whenever agitation in favor of national legislation has made the subject one of national interest. Such an agitation seems to be upon us and an able presentation of the subject has appeared in a pamphlet by Walter Renton Ingalls, "Systems of Weights and Measures." Mr. Ingalls' reason for presenting once more and at this time his arguments against adoption of the metric system are contained in the preface to his little book and is based on "a recrudescence of prometric propaganda, which is strangely persistent, both in Great Britain and in the United States of America." He continues: "An argument that has recently been offered is that adoption of the metric system has heretofore been put off owing to the confusion that appeared inevitable, but that now, when practically all regular production has been suspended, owing to displacement by military production, it is a logical time to make the change."

If the subject is to become a live one with serious threats to some form of general adoption and legal compulsion, then the arguments for and against adoption must be repeated and persons who will be affected by any change, and all of us will be, and persons who will be influential in urging or opposing adoption should be well informed on both sides of the controversy.



MARSH BUGGY NO. 3 WITH ENGINEERS RESPONSIBLE FOR ITS DESIGN AND CONSTRUCTION; E. W. JACOBSON, RIGHT, AND B. M. WEDNER

The GULF MARSH BUGGY

By E. W. JACOBSON

GULF RESEARCH & DEVELOPMENT COMPANY, PITTSBURGH, PA. MEMBER A.S.M.E.

THE "marsh buggy" was developed in 1936, by engineers of the author's company, to meet the need for transportation across the grassy marshes of the Gulf coast areas so that the Gulf geophysical prospecting parties could search that area for potential oil deposits. The Gulf coast area consists in general of wide stretches of marshland which are interspersed with patches of open water. The marsh consists of grassy vegetation floating in great part on the water. There is no support for man or vehicle, except the root mat under which there may be soft mud as deep as 100 ft in some places. The vegetation grows as high as 12 or 15 ft and presents an impassable obstacle to any kind of a vehicle except a large buoyant-wheeled vehicle which is driven on all four wheels.

EARLIER TYPES OF MARSH VEHICLES

Several types of vehicle had been tried prior to the Gulf marsh-buggy design. First among these were vehicles having a boatlike body with caterpillar treads along each side, and those having a Ford auto chassis with wide slat-type wheels. Neither of these earlier vehicles could operate in soft marshes where open water was encountered; the first, because of the abrupt walls of high vegetation growing at the edge of open water and the resistance of vegetation growing in the water; the second failed because of lack of buoyancy. The Gulf marsh buggy was the first attempt of the Gulf Oil Corporation to build a suitable vehicle.

Native fur trappers frequent these difficult marshes using shell-type canoes called pirogues. They work their way through the grass, opening up narrow canals along which they push their craft.

Gulf has now built three of these marsh buggies and two equipment trailers. The first vehicle has been in operation in Louisiana since August, 1936. The second vehicle was built in 1937. An equipment trailer, consisting of a chassis mounted on two buoyant wheels, was built in 1938. These two buggies and the trailer have been used as a team on one of the Gulf geophysical prospecting parties carrying gravimetric and seismic geophysical prospecting parties throughout the marshy areas. Several very productive salt-dome-type oil deposits have been discovered by the use of these vehicles. Gulf has now built a third marsh buggy and trailer which is being sent to Central America for use in geophysical prospecting in difficult tropical marshy areas there. The third buggy was completed about May 10, 1945, and is now in service in Central America.

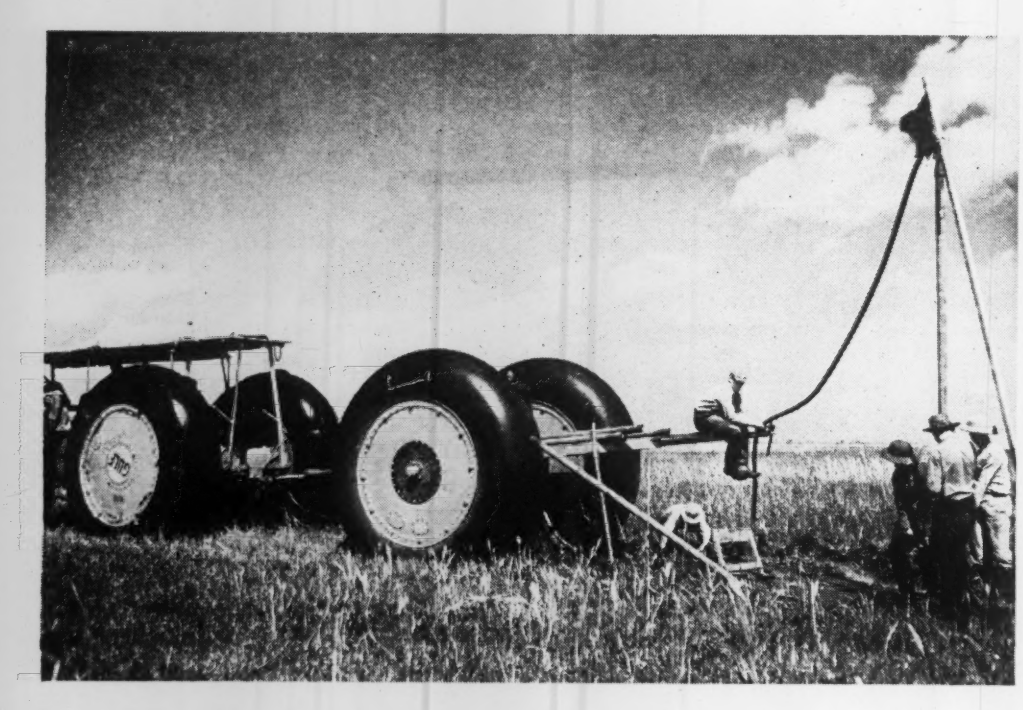
DETAILS OF THE MARSH BUGGY

The general design of the vehicle, which is covered by U. S. letters patent, is based on the use of buoyant wheels, all power-driven, of such proportion that the buoyancy of the wheels is sufficient to support the entire vehicle even in open water with not more than one fourth of the wheels immersed. The designs were worked out by engineers R. J. S. Pigott, Abbott A. Lane,[1] E. W. Jacobson, and B. M. Wedner, all members of the A.S.M.E.

The marsh-buggy tires are 10 ft outside diameter with smooth tread. Traction is obtained by detachable cross links. The total weight of the vehicle is 7500 lb and it will carry a live load of 1500 lb or more. The buoyancy of the wheels is such that the vehicle in the loaded condition is completely supported when floating in water with the tires submerged only to the edge of the rims.

The over-all length of the buggy is 22 ft 6 in., and the over-

[1] Now associated with the American Agricultural Chemical Company, New York, N. Y. Mr. Lane resigned from the Gulf Research & Development Company in September, 1939.



MARSH BUGGY AND TRAILER IN OPERATION; CREW DRILLING SHOT HOLE

all width is 11 ft 8 in. By using the large wheels, ample clearance under the vehicle chassis is obtained to facilitate movement in and out of water with high marsh vegetation at the water's edge. The wheels themselves are watertight drums of such buoyancy that the vehicle would still float in water even though all the air were lost from the tires. The tires are like auto tires, having a casing and an inner tube.

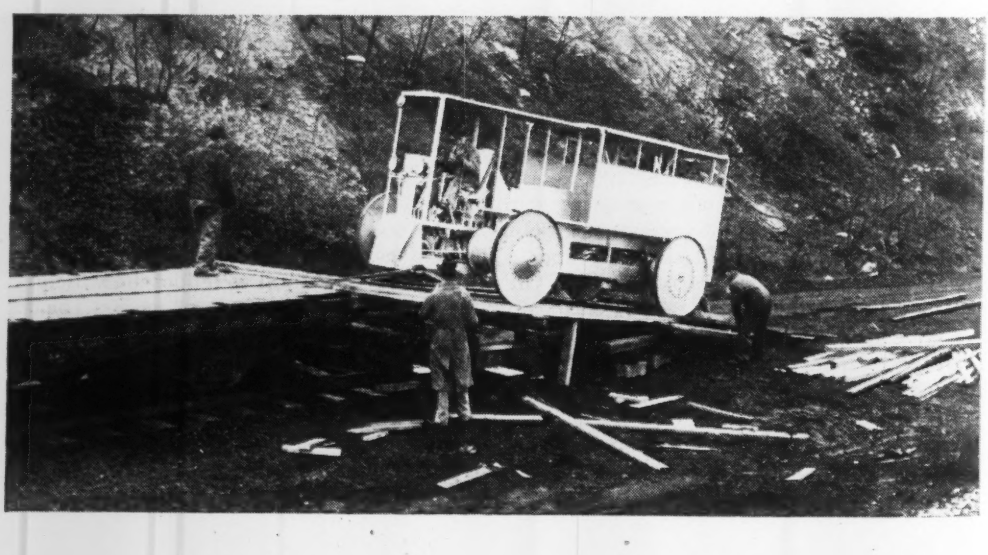
The Gulf marsh buggy is powered by a Ford V-8 pleasure-car engine driving a Ford transmission and an International Harvester transmission. By means of these two transmissions, operating speeds from $1\frac{1}{2}$ to 35 mph are possible, depending on the type of terrain encountered. The tractor transmission is fastened by means of flexible rubber mountings to the vehicle frame, and the rear wheels are mounted on the ends of the extended axles. The front wheels are mounted on a center-pivoted front axle and are driven through large universal joints by chains from sprockets on the rear-wheel hubs. Separate brakes on either side are provided for use in guiding the buggy in open water in conjunction with the conventional automobile-type steering gear. The chassis is without springs as the tires are amply flexible. The centrally pivoted front axle can move enough to allow one wheel to rise 2 ft above the other, in passing over rough country, without twisting the frame.

The operator's seat is mounted forward in the vehicle, directly over the front axle, and the controls and gear shifts are brought up to that position. Even though the operator's head is above the top of the tires he is still unable to see over some of the marsh grasses and vegetation which oftentimes grows from 12 to 15 ft in height. The vehicle is equipped with marine lights, etc., to meet the regulations of motorboats, and also carries automobile headlights, horn, and tail lights.

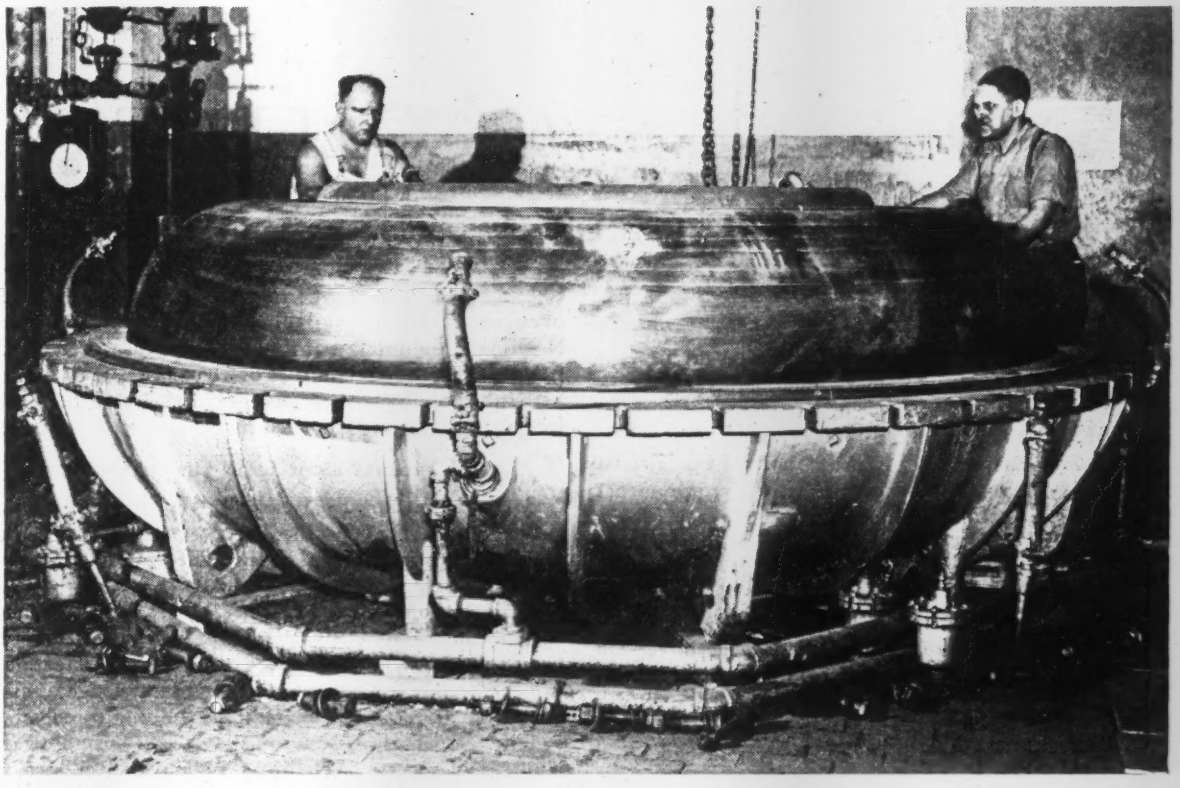
LARGEST PNEUMATIC TIRES EVER BUILT

The tires are the largest pneumatic tires ever built which are suitable and adequate for a variety of commercial purposes. They were manufactured and molded according to conventional tire-manufacturing practice. All of the materials used are of the finest quality and are similar to those in first-line tires for trucks and automobiles. The tire dimensions and weights are as follows: Over-all diameter of tire casing, 120 in.; sectional diameter of tire casing, $33\frac{1}{2}$ in.; diameter of tire rim, 66 in.; weight of tire casing, 315 lb; weight of service inner tube, 125 lb.

The tires for the Byrd "snow buggy," which received con-



MARSH BUGGY WITH TIRES AND WHEELS REPLACED BY STEEL SHIPPING WHEELS, BEING LOADED ON RAILROAD CAR



TIRE FOR MARSH BUGGY READY TO BE REMOVED FROM MOLD AT THE GOODYEAR TIRE & RUBBER COMPANY

siderable publicity some years ago, were made on the same mold. The marsh buggy tires are four-ply with two breaker strips on the tread and about $^1/_8$-in. rubber over all the carcass. The Byrd snow-buggy tires were twelve-ply with considerably more rubber on the tread and carried high pressures.

Marsh-buggy tires operate on from 3 to 5 psi pressure. Only 1 psi pressure is required for holding the tire in shape and supporting the load. However, 3 to 5 lb are required so that the casing will grip the rim of the wheel. In case of a tire leak or puncture a Roots blower is provided, the discharge from which is piped through the axles into each tire so that the tire can be inflated when in operation. The tires have been operated by this means even with comparatively large holes torn in them. The first tires operated 7 years in continuous duty in salty-marsh country before they were replaced. Some of them had been repaired several times.

SPECIAL TIRE MOLD DEVELOPED

When built, the curing mold was the largest and only one of its kind. It is a steam-jacketed mold and though there was nothing new about a steam-jacketed tire mold, the extraordinarily large size of this mold called for the solution of new problems in mold design. The design and engineering work on the mold was all done by the development and engineering departments of the Goodyear Tire & Rubber Company

The mold consists of four principal parts, namely, the top half, the bottom half, the top mold ring, and the bottom mold ring. All four parts are honeycombed with steam cavities which involve a complicated pouring operation in the foundry. A uniform distribution of heat throughout the mold is absolutely essential. To accomplish this four steam inlets and four outlets were provided in both the top and bottom halves and two steam inlets and outlets in both the top and bottom mold rings. Twelve traps were required to take care of the exhaust steam. Temperature- and air-control instruments were included in the installation to insure a uniform cure in accordance with specifications. The total weight of the mold installed is approximately 23 tons. Both the top and bottom halves are made from single castings and weigh almost 10 tons each. The over-all diameter of the mold is 12 ft. The operation of this mold has been very satisfactory from the start, and every tire put in has come out with uniform and correct cure.

The other equipment used in the manufacture of the tires follows that for standard tire-building practice, except that it is of much larger size. The casing is built up on a cylindrical form and then expanded into shape by means of a specially built tube exactly similar to the manufacture of automobile and truck tires. The inner tubes are similar to conventional inner tubes but were fabricated by building up from sections of the rubber material. The tire valves should have special mention, for a valve suitable for these low-pressure tires had to be developed, as there was no valve commercially available for this application.

WIDESPREAD POPULAR INTEREST IN UNUSUAL VEHICLE

The Gulf marsh buggies, because of their unique design for amphibious operation and their exceedingly large tires, have received almost continual international publicity since they were put into use in 1936. They have appeared in newsreels year after year. Articles have appeared in such magazines as *Life*, *Time*, countless newspapers, *Engineering* (London), and even the *Egyptian Gazette*. A photograph of the marsh buggy was used for the cover of the English magazine, *Meccano*, and on the *Popular Science Monthly*. During the past year Paramount News Studios prepared a newsreel short covering the Gulf geophysical operations using the marsh buggies, and this newsreel is now being shown not only throughout the United States but also before all the Armed Forces.

The marsh buggies have contributed considerably to the war effort in discovering new and important oil fields. They have been called on from time to time to enter otherwise impassable sections of the Louisiana marsh country to pick up aviators who have been forced to come down in those areas. No other means of transportation would permit recovery of these men.

A Reply From INDUSTRY *to the* COLLEGES[1]

By M. M. BORING,[2] A. R. STEVENSON, JR.,[3] and K. B. McEACHRON, JR.[4]

A GLANCE AT THE RECORD

THE importance of engineering education to the future of industry in America has been strikingly emphasized during the war years. Remarkable achievements in education have paved the way for the miracles of industrial production that have characterized this war.

The colleges and universities of the country have altered their programs to a remarkable degree to fit the requirements of the Armed Forces. In many instances these changes have led to new and improved methods of teaching which can be readily applied to education for peacetime engineering.

THE JOB AHEAD

In the concern of the nation for the problems of reconversion of industry there is often little recognition of the significant reconversion job which the colleges face. We are particularly aware of its importance and magnitude because of our close contact with college graduates and our interest in education generally.

In recent months colleges have been asking the assistance of industry in planning postwar college curricula. Although few men in industry have ever taught in a college or university, many have had considerable contact with the college graduates who are hired annually by industrial concerns. Industry is rightly realizing the importance of education in engineering and welcomes an opportunity to discharge a part of its responsibility in this field by co-operating with the colleges in studying postwar curricula.

The Accelerated Schedule. There is grave danger that some colleges and the public generally may believe that an accelerated college program is superior to the prewar college schedule. Experience with those graduates employed in the last two years leads us to believe that the engineering graduate of an accelerated program is limited, compared with his prewar predecessor, in his ability to analyze engineering problems from fundamentals.

Students enter college much earlier than usual, with the result that few of them are sufficiently mature or emotionally adjusted for the college experience. Elimination of most free time in the accelerated schedule has drastically reduced the effectiveness of instruction. Those who advocate continuing the accelerated program fail to recognize the loss to the national culture and the lack of all-round ability of engineering graduates under such a program.

The Immediate Need. Some educators and industrial representatives will see in the reconversion facing the colleges an unusual opportunity to make sweeping changes. Although needed changes should be introduced wherever possible, we should recognize that the primary emphasis is upon the necessity of returning to basic college curricula as rapidly as possible. Except for men returning from the services, a negligible number of engineers will be available to industry in the next few years. Nothing should delay an immediate return to regular college programs in order that this barren period may be as brief as humanly possible. Any changes that are to be made, therefore, must not delay this return.

PRIMARY EMPHASES IN THE CURRICULUM

Basic Engineering Fundamentals. Engineering education in college must be concerned with engineering fundamentals rather than specialized design. The war has shown us that radically new designs must usually be based on the fundamentals of engineering rather than on previous design. It is far more important, therefore, for the college graduate to have a thorough understanding of all the fundamentals underlying engineering rather than detailed knowledge of any specific design or device. For example, a thorough understanding of such fundamentals as Newton's laws is of far more value in the solution of general mechanics problems than a host of specialized formulas.

Many will take exception to these beliefs, pointing out that widespread acceptance of them would lead to a single unified undergraduate engineering curriculum. At least one educational institution has done exactly that with success. In the authors' company, little recognition is ever taken of the branch of engineering in which a person was graduated, as the requirements of any electrical manufacturer so combine the mechanical, electrical, and chemical fields as to be almost inseparable.

The Case for Specialization. It has been argued in the past that the colleges must provide specialized training rather than fundamental understanding because many small companies do not have educational programs which will assist the graduate in obtaining practical experience. It is our belief that it is no more practical to graduate full-fledged engineers from college than practicing doctors from medical school. Perhaps because the materials with which the doctor deals are irreplaceable, we have recognized the importance of interneship earlier in this profession than in engineering. It is nonetheless essential to the successful training of outstanding engineers.

Some attempt has been made to recognize such an interneship or apprenticeship by the provision of some states, notably New York, for an "Engineer-in-Training" level of the professional engineers. Such an apprenticeship means that a small company without even a single good engineer who is capable of educating newer men cannot hope to supply this need directly from the colleges but must employ from some other concern an older engineer who has had both education and practical experience. In other words, there is no substitute for apprenticeship in the best sense of the word in engineering as well as in mechanical trades.

Stimulating Ingenuity. A second equally important consideration which must be borne in mind in discussing college curricula is the stimulation of the native ingenuity of undergraduates. During the war period, students have not usually been encouraged to think for themselves in the rush of absorbing detailed knowledge in a rather limited field. We believe that emphasis on engineering fundamentals and ingenuity go hand in hand to develop a successful engineer. To encourage

[1] This paper has been written in response to a number of specific requests addressed to the authors from the colleges asking advice and criticism about proposed engineering curricula. It was presented to the S.P.E.E. Committee on Relations With Industry and endorsed by the committee on March 13, 1945.

[2] Staff Assistant to Vice-President, in Charge of Engineering, General Electric Company, Schenectady, N. Y. Mem. A.S.M.E.

[3] Staff Assistant to Vice-President, in Charge of Engineering, General Electric Company. Fellow A.S.M.E.

[4] Engineering General Division, General Electric Company.

the ingenious student further, the curricula of the future should provide opportunity for the design and construction of ingenious electrical and mechanical devices.

The educational purpose will be better satisfied and more such projects can be provided by the colleges if such devices are small and simple rather than large and complex. At least one college in the Southwest has scheduled this type of a design class with the additional condition that only students who have demonstrated a certain minimum of ingenuity and who strongly desire to take such a class will be enrolled. Students in the past have often been required to take college design courses regardless of their interest in electrical design. Such design classes have seldom involved actual physical design and development of ingenious devices. We believe that the plans for classes such as that suggested will stimulate interest in design and development to an unusual degree.

Extent of Electronics. It is hardly possible today to discuss engineering curricula without touching upon the subject of electronics. The special needs of the war have stimulated an unusual interest in this subject. The need for technically trained personnel acquainted with electronics principles has resulted in the inclusion in most engineering curricula of a number of courses specifically designed to answer such a need.

Although training in electronics during the prewar years was probably inadequate to meet industrial demands, this recent emphasis on education in electronics exaggerates the relative importance of this phase of the electrical industry in the postwar period. In the authors' company, for example, estimates of postwar business indicate that the apparatus lines will still be ten times greater than the communications business. We are therefore vitally interested in maintaining a proper ratio between education provided by the colleges along these two directions.

In general, it is preferable to give the student engineer a broad concept of the complete frequency spectrum, emphasizing particularly the fundamentals underlying the operation of devices at any frequency. Thus, whenever need arises for a fundamental understanding of high-frequency problems, the basic principles are already well understood. In addition to presenting proper technical material, the college must also be prepared to stress the relative importance of communications compared with the other branches of engineering.

Preparation for Citizenship. Many articles have appeared in the technical press in recent months emphasizing the importance of the nontechnical portion of an engineering undergraduate curriculum. There is no doubt that recognition of the more cultural and liberal phases of education has been too long ignored in engineering colleges. Here also, however, there is some reason to advocate caution in the extent to which the nontechnical part is increased. It is beyond question that some engineers adequately prepared technically have found great difficulty in adjusting themselves to industry and developing an active participation in society and community life as a result of their lack of understanding and appreciation of nonengineering subjects. Great care must be experienced in the way in which such subjects are taught if maximum benefit is to be derived. In his book "On Education,"[5] Sir Richard Livingstone is particularly emphatic concerning the periods in a person's life when such material can be most usefully absorbed:

"That is, you cannot study fruitfully liberal subjects, among them philosophy and politics, unless you know something of life. On the other hand, there are subjects, such as mathematics, which a boy or undergraduate is fully capable of understanding, even if he knows nothing outside the walls of his home, school, or university. For whereas politics and ethics are concrete, mathematics is purely abstract and theoretic and does not spring from life or need experience of life to illuminate or correct it."

[5] Quoted by permission of the publishers, the Macmillan Company, New York, N. Y.

We believe that the principal purpose of such subjects as English, public speaking, and art of dealing with others, in engineering curricula should be to acquaint the undergraduate with the importance of these subjects and to develop his appreciation for them as essential to his future career even as an engineer. Too often in the past an attempt has been made to get across a certain minimum of information rather than an attitude of mind. All of these liberal subjects should be taught by a person who has a sincere appreciation for the role of the engineer in society and who can fully understand the engineering point of view. It is only such leadership that can stimulate and impress the young engineering student with the importance and value of such liberal material.

For example, much of the student's antipathy for English can be traced, we believe, to a lack of understanding of the engineering student by his English professor. This point is particularly well illustrated in a recent article[6] by A. M. Buchan. This same article describes the effect of encouraging the professor of liberal subjects to appreciate the relation of engineering to society in these words:

"The professors learn from their students. An interest in technical subjects has been born, and the old literary bias against them is disappearing. A notion of culture as an attitude assumed toward any subject, technical or philosophical, rather than as familiarity with certain arts and books begins to appear, and the teacher of Wordsworth or Thoreau finds himself engaged, and happily, in discussing baking methods or the development of alloys. For the teacher of speech, too, there can be a realization that the orderly description of a coke oven is just as valuable practice as an argument on Fascism."

We would also suggest that in spite of the modern tendency to depreciate the value of foreign languages in the curricula, there is a real value in the study and mastery of languages other than our own. The study of history, economics, and civics should not be neglected, but in these also emphasis should be placed upon developing an attitude of mind in the student which will make him aware of the engineer's responsibility as a member of society and the large part which he should play in such society.

ADULT EDUCATION FOR ENGINEERING GRADUATES

Recognition of the importance of adult education has increased greatly in the past few years. A quotation from Sir Richard Livingstone mentioned earlier[5] suggests that intensive study of cultural or liberal subjects, such as philosophy and politics, is properly postponed beyond graduation and should be reserved for a later period in the engineer's life when he has had some experience outside the school. There has been a strong tendency for the college graduate to consider his education completed.

The proper attitude toward education as a process of continual growth should be stressed again and again to the undergraduate He will then recognize that without education there can be no growth, and without growth of individuals there can be no progress. Rarely has a graduation address failed to dwell on this aspect of education. Yet much of the student's previous conditioning in college creates an opposite attitude. The Engineering Council for Professional Development has recognized the need of engineers for adult education, particularly in liberal subjects, and has strongly supported the demand for adequate adult education.

What Has Been Done. In Denmark, "high schools" have been established to provide liberal education for adults. What has been accomplished in this field in this instance is strikingly described by Sir Richard Livingstone[5] in these words:

". . . the Danish People's High School, should be of peculiar interest to us for it is the only great successful experiment in

[6] "English in Basic Army Courses," by A. M. Buchan, Proceedings of the Society for the Promotion of Engineering Education, vol. 51, 1943–1944, pp. 535–540.

educating the masses of a nation. It has reached the very classes for which we have done little or nothing. It has taught them to care for subjects like history and literature which seem remote from the man in the street. It has transformed the country economically, given it a spiritual unity, and produced perhaps the only educated democracy in the world. Here is that rare thing in education—an ideal embodied in fact. It is curious that it has excited comparatively little attention among ourselves who are facing the problem which these Danish schools have solved.

"We find it difficult to think of Denmark as a poverty-stricken country lacking in energy or enterprise; but such it was in the early nineteenth century, and its transformation into one of the most progressive and prosperous democracies of Europe was largely the work of the education given in these schools. . ."

A New Area of Engineering Education. We believe that the colleges and universities of the country should take the lead in providing adequate opportunities for education in liberal subjects for engineering graduates. In many cases this may involve considerable rearrangement of schedules and programs to accommodate evening classes. The teachers of these classes will also benefit greatly because, for the first time, they will have students whose "experience of life" is fully as great as their own. The class members will thus contribute much to the instruction of the class. The value to the nation and to the individual adult student far outweighs the difficulties which must be overcome to provide such opportunities.

THE MOST IMPORTANT FACTOR IN EDUCATION

Although revision of engineering curricula is a laudable undertaking, it is almost useless to consider such changes apart from the teaching staff. The failure to stress the significance of outstanding teachers in college education is to neglect the most important factor in education. No opportunity should be overlooked to attract outstanding engineers to the teaching profession.

The question has often been raised as to whether there is a wide difference in salary levels between industry and education which deters a young man from considering a career in education. The problem is well illustrated by a recent comment by Dean C. J. Freund of the University of Detroit: "There are such (ideal professors) but most colleges cannot afford them. It has been my experience that after an outstanding teacher has been developed, he will someday be a luncheon or dinner companion of the president of a manufacturing or industrial corporation. He impresses the president who very soon thereafter offers the professor or assistant professor a salary which is fabulous according to college standards. The professor may be an idealist and he may be devoted to his university, but there are limits even to generosity and heroism."

The Contribution of a Great Teacher. Many schools would undoubtedly never be able to employ a full complement of outstanding teachers at adequate salaries. Such schools would find it profitable to make use of undergraduate leaders, selected for their brilliance and teaching ability, in order to obtain maximum benefit from the really few born teachers which the college could hire.

"A great teacher is a man whose personality is so attractive and whose character is so fine that by unconscious tuition he wins the admiration and lifelong devotion of his students and all unconsciously influences their ideals and molds their characters so that they are forever after better men for having sat under him. There is no substitute for the inspiration and guidance which such a man can contribute."[7]

Wherever there are great men, there is so often a great teacher behind them. There is nothing more important than teaching. There are many outstanding teachers in the colleges now; their numbers must be increased. We must have the best and most capable men in the nation guiding the education of youth.

LEADERSHIP—A PRESSING NEED

No discussion of college education would be complete without mention of leadership. America has long been noted for its educational system, in particular, for the high level of the average intelligence of its citizens. In our desire to improve the average intelligence, we have more and more neglected the brilliant individuals. We must recognize that the contributions to society of an Edison, Marconi, or Alexanderson are far greater than those of scores of John Does. Without depreciating the necessity for mass education, we must in the future concentrate on developing an equally good system for educating the outstanding individuals.

We have great interest in the proposal that undergraduate leaders be selected to assist the regular professors. These carefully selected young leaders, if given proper freedom, could do a much better job of stimulating the students than some of the present instructors who remain on the college pay rolls without promotion for several years. The average pupil would thus simply go through the classes in the present manner, the outstanding student would get the extra opportunity, responsibility, and incentive of teaching a younger class. In addition, the substitution of these undergraduate leaders for regular instructors would release sufficient funds to hire a few really brilliant outstanding professors. Such men would be required to have the ability of working closely with the undergraduate leaders, stimulating and inspiring them, yet making each responsible for his class.

THE AIMS OF EDUCATION

There are then these principal goals toward which the colleges should continue to strive: A stronger emphasis on broad engineering fundamentals; an appreciation of the role of the engineer in society for all college students; and the creation of leadership of a high order. The degree to which we can attain these objectives will determine the future of engineering and of all America.

A SURVEY of the reconversion plans of 62 industries, conducted by the War Production Board, shows that most of them expect large decreases in the value of their outputs even at full-capacity operations after peace returns. Most of them are now producing war goods, and currently the combined values of their outputs amount to 14 billion dollars a year. They esimate that the total value of their output of peacetime goods at full-capacity operations would amount to 10 billion dollars. Such a rate of production would require the construction of plant expansions and alterations that would cost about 235 million dollars.

Among the 58 industries that gave full information about their expectations there were 33 which anticipated decreases and 25 which expected increases. Among the 33 companies that anticipate shrinkages . . . . the value of the wartime outputs is over 12.4 billions, and that of the expected peacetime values is only 6.6 billions.

By far the most important factor in that great discrepancy is the passenger-automobile industry. It is now largely devoted to making war goods which it is currently turning out at the rate of 8.61 billion dollars worth a year. It expects that at full-capacity operations when peace returns its yearly output will shrink to a value of only about 4.51 billion dollars. The 25 industries that expect expansions . . . are producing at the annual rate of nearly 1.7 billions, and they hope to expand to about 2.6 billions after peace returns.

If nearly all the industries have made relatively reliable forecasts, their figures indicate that it may prove difficult to find full employment for all the factory workers after peace returns.—*The Cleveland Trust Company Business Bulletin*, June 15, 1945.

---

[7] "Unconscious Tuition," by H. N. Davis, MECHANICAL ENGINEERING, vol. 61, 1939, pp. 113–114.

RADIAL RAKE ANGLES *in* FACE MILLING[1]

3—*Milling Cutters With Double Radial Rake Angles*

By J. B. ARMITAGE[2] and A. O. SCHMIDT[3]

THE object of this series of tests was to investigate the effect of cutting speed on tool life and chip formation of a combined positive- and negative-radial-rake-angle cutter. Results of the investigation were compared with those of a similar investigation on negative-radial-rake-angle cutters.

The fly cutter used had a 15-deg positive secondary radial rake angle and a 10-deg negative primary radial rake angle, 0.016 in. wide, at the cutting edge. Fig. 1 shows the carbide tip as it was used in these tests. Test-bar and cutting-tip material are the same as used in similar tests with negative-radial-rake-angle cutters. All other conditions were kept unchanged and are listed in Table 1.

TABLE 1 TEST CONDITIONS

Variable Factor: Cutting speed (130–3280 fpm)
(All other conditions held constant)
New carbide blade used at each speed
Two cuts, 10.8 cu in., made with each blade

Cutter:	Cut:
Face mill, single blade of solid carbide, wedged	Work centered with cutter
Diameter, in. 10	Width, in. 3
Radial rake, deg, 15 pos, 10 neg	Length, in. 12
Axial rake, deg 0	Depth, in. 0.150
Peripheral cutting edge angle, deg 30	Volume, cu in. 5.4
	Feed per tooth, in. 0.010
Workpiece:	Machine:
S.A.E. 1020, Bhn 180	Milwaukee 50-hp C.S.M. vertical

In Figs. 2 to 9 cemented-carbide cutting tips are shown as they appeared after removing 10.8 cu in. of steel at various speeds. The tip in Fig. 9 had removed only 4 cu in. of metal when the test was stopped in order to provide a comparison with a negative-radial-rake-angle blade reported in Section 2.

For all cutting speeds investigated, wear at the cutting edge was generally less for the double-radial-rake-angle cutters than for negative-radial-rake-angle cutters. None of the chips removed in this test by the double-radial-rake-angle cutters are shown but they all followed a pattern similar to those removed by negative-radial-rake-angle cutters. In general, chips were longer and of uniform shape for cutting speeds up to 1720 fpm.

At higher cutting speeds the crater worn into the blade face edge caused a tighter curl in the chips. In all instances, however, the chips produced by the cutter with a double radial rake angle were not curled as tightly as chips removed with negative rake angles. This is a natural result since the crater behind the cutting edge did not begin to assume a definite shape until the combined-angle cutter had removed more metal than the negative-angle cutter at a comparable stage of wear. The lighter colors of chips at all speeds indicate that combined-angle cutters consume less power at the cutting edge than negative-angle cutters.

The cutter with combined angles revealed a tendency to wear less rapidly than cutters with negative angles. Application of the double-radial-rake-angle principle to milling cutters results in several advantages, i.e., power consumption is lowered, carbide tip material is used more economically, tool life between grinds is increased, and cutter regrinding time is reduced.

PRACTICAL APPLICATION OF THE DOUBLE-RADIAL-RAKE-ANGLE CUTTER

A four-blade cutter, Fig. 10, 4 in. diam with a 30-deg positive secondary radial rake angle and a 6-deg negative primary radial rake angle was used in test cuts on mild steel and various nonferrous metals. Wedges used to hold the blade mechanically were located in back of the blade and thus the cutter body could be provided with ample, unimpeded, chip-accommodation space. Depth of cut on the $2^1/_2$-in-wide workpiece was varied to a maximum of 0.350 in. Chips removed from the workpiece by this cutter were uniform in shape, and comparatively low chip temperatures were indicated by the light temper coloring.

Fig. 11 illustrates an 8-in-diam cutter with eight solid-carbide blades mechanically held in slots by wedges located behind the blade. The 30-deg positive secondary-radial-rake-angle blade was provided with a 6-deg negative primary radial rake angle 0.015 in. wide at the cutting edge. This cutter was an all-purpose tool for mild steel, cast iron, and various nonferrous alloys. For mild steel and cast iron a 6-deg negative primary radial rake angle was used, while a 6-deg positive primary radial rake angle was used for aluminum. Both positive and negative primary radial rake angles could be ground on the same cutter to suit different workpiece materials.

A 10-in-diam cutter with 12 teeth is shown in Fig. 12. Location of the holding wedge behind the cemented-carbide cutting blade permitted ample space for a large smoothly formed chip clearance in front of the blade. Since steel chips exhibited a tendency to weld to the hardened body during heavy cuts and thus interfere with chip removal, the chip-clearance surface was chromium plated. This cutter was used in a number of production operations and was compared with brazed and mechanically held solid-carbide-tipped cutters.

Despite the fact that this cutter often removed much more metal than the other cutters, only a small amount of regrinding was necessary, usually not more than 0.005 in. on the periphery and face. An extra grinding operation was required to form the primary radial rake angle at the cutting edge.

Figs. 13, 14, and 15 show chips removed from the test bar by the 4-in-diam, 8-in-diam, and 10-in-diam cutters, respectively. These chips were uniform in shape, longer and thinner than those removed by comparable cutters without the positive radial rake angle. Light temper colors of chips removed by these cutters indicate low chip temperatures and, consequently, low power consumption.

Comparative wattmeter readings on production milling operations with negative-angle and combined-angle cutters revealed that the latter would often perform an operation with 30 per cent lower power consumption. It is not always possible to realize minimum power consumption for a given operation be-

[1] Sections 1 and 2 of this paper appeared on pages 403–406 of the June, and pages 453–456 of the July, 1945, issues, respectively, of MECHANICAL ENGINEERING.

[2] Vice-President in Charge of Engineering, Kearney & Trecker Corporation, Milwaukee, Wis. Mem. A.S.M.E.

[3] Research Engineer in Charge of Metal Cutting Research, Kearney & Trecker Corporation. Mem. A.S.M.E.

Contributed by the Production Engineering Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

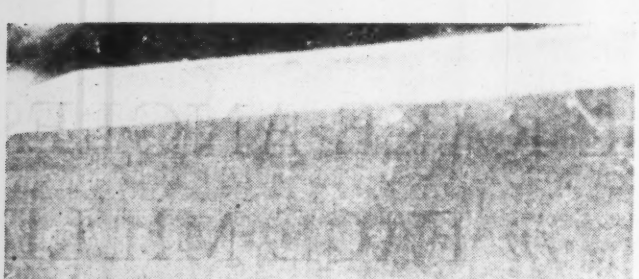


FIG. 1 NEW CARBIDE EDGE USED IN TESTS
(Surface finish 9 to 12 microinches. The tip was not honed.)

FIG. 2 CUTTING EDGE AT END OF TEST AT 130 FPM
(Workpiece material adheres to positive-radial-rake face of tip.)

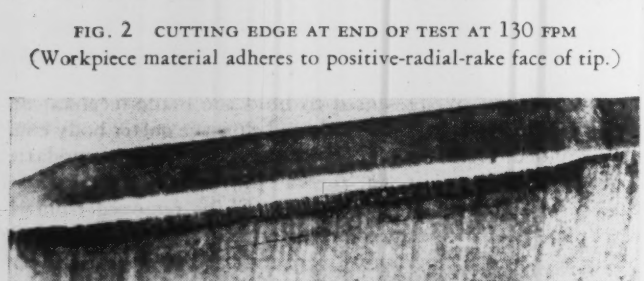


FIG. 3 CUTTING TIP AT END OF TEST AT 582 FPM
(Slight wear appears at juncture of positive and negative radial rake angles.)

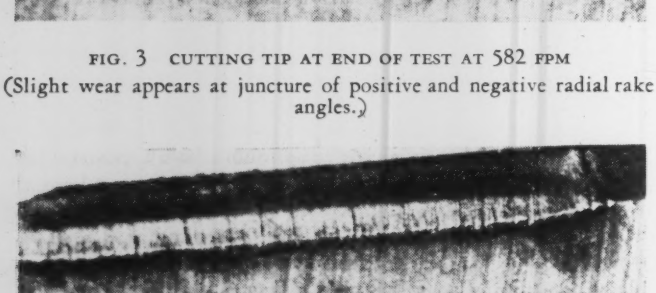


FIG. 4 CUTTING TIP AT END OF TEST AT 895 FPM
(Incipient crater visible.)

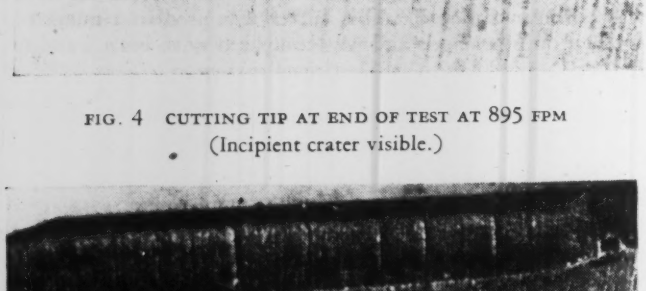


FIG. 5 CUTTING TIP AT END OF TEST AT 1385 FPM
(Crater more pronounced but still shallow.)

FIG. 6 CUTTING TIP AT END OF TEST AT 1720 FPM
(Crater extends nearly to cutting edge.)

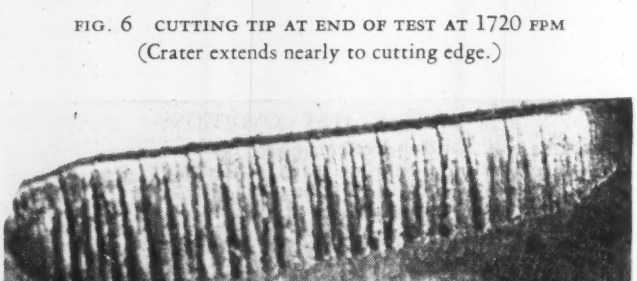


FIG. 7 CUTTING TIP AT END OF TEST AT 2140 FPM
(Wear has removed primary-negative face almost completely.)

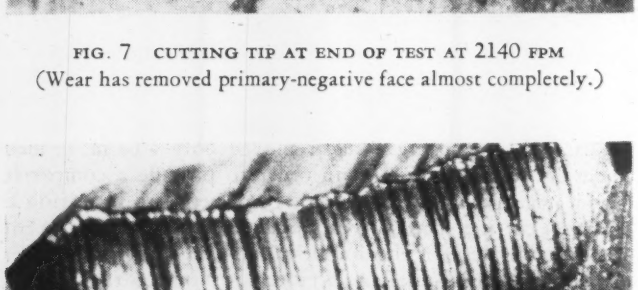


FIG. 8 CUTTING TIP AT END OF TEST AT 2650 FPM
(Completely failed due to excessive cratering of 0.030 in.)

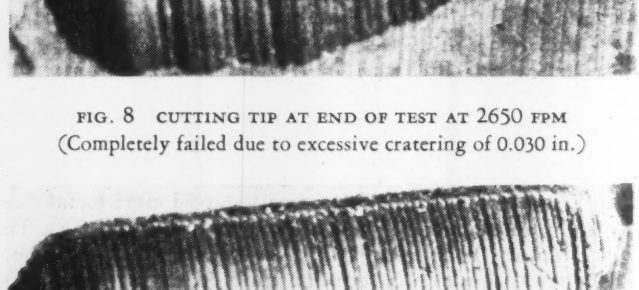


FIG. 9 CUTTING TIP AT END OF TEST AT 3280 FPM
(Only 4 cu in. of metal was removed with this tip.)

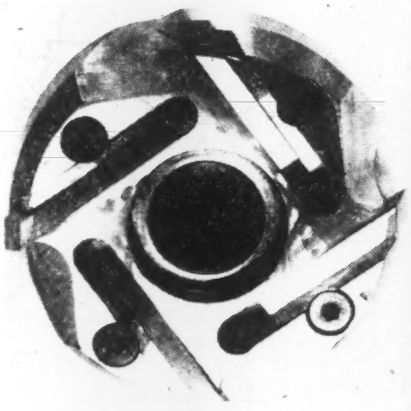


FIG. 10 CUTTER 4 IN. DIAM WITH INSERTED BLADES AT 30-DEG POSITIVE SECONDARY RADIAL RAKE ANGLE WITH NEGATIVE PRIMARY RADIAL RAKE ANGLE AT CUTTING EDGE

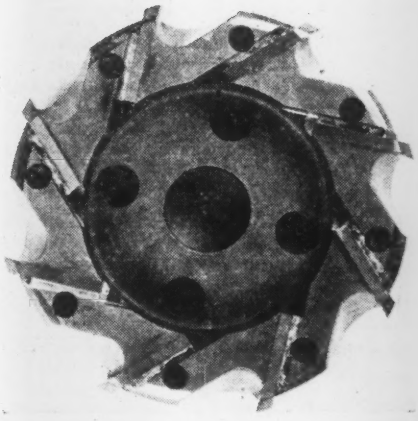


FIG. 11 CUTTER 8 IN. DIAM WITH 8 INSERTED BLADES AT 30-DEG POSITIVE SECONDARY RADIAL RAKE ANGLE WITH NEGATIVE PRIMARY RADIAL RAKE ANGLE AT CUTTING EDGE

FIG. 12 CUTTER 10 IN. DIAM WITH 12 INSERTED BLADES AT 15-DEG POSITIVE SECONDARY RADIAL RAKE ANGLE WITH NEGATIVE PRIMARY RADIAL RAKE ANGLE AT CUTTING EDGE

FIG. 13 CHIPS REMOVED AT 428 FPM FROM TEST BAR $2^1/_2$ IN. WIDE BY CUTTER SHOWN IN FIG. 10

(Material cut, NE 8022, 180 Bhn; depth of cut, 0.300 in.; feed per tooth 0.018 in.)

(*a*)

FIG. 14 CHIPS REMOVED AT 480 FPM FROM TEST BAR 5 IN. WIDE BY CUTTER SHOWN IN FIG. 11

(Material cut, NE 8022, 180 Bhn; depth of cut, 0.150 in.; feed per tooth 0.010 in.)

(*b*)

FIG. 15 CHIPS REMOVED AT 520 FPM FROM TEST BAR 5 IN. WIDE BY CUTTER SHOWN IN FIG. 12

(Material cut, S.A.E. 4340, 200 Bhn; depth of cut, 0.200 in. *a*, Chips removed with feed per tooth 0.015 in. *b*, Chips removed with feed per tooth 0.022 in.)

cause tool wear and workpiece irregularities must be taken into consideration when a combination of angles is chosen.

CONCLUSION

1 Wear on the cutting edge increases with an increase in cutting speed but the cutter with double radial rake angles, i.e., the cutter with a positive secondary radial rake angle and negative primary radial rake angle, reveals better wearing qualities than a negative-radial-rake-angle cutter operating under similar conditions.

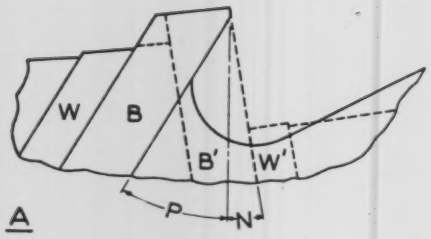
2 Any reduction in wear at the cutting edge increases tool life between regrinds.

3 Less carbide is removed in the sharpening operation on combined-angle cutters, thereby utilizing a vital material to the greatest extent.

4 Application of double radial rake angles in cutter design will reduce power consumption at the cutting edge with a resultant increase in machine efficiency.

5 Lower power consumption at the cutting edge lessens cutting forces acting on machine elements and the workpiece.

Figs. 16 to 19 illustrate graphically several advantages of double-radial-rake-angle cutter construction.



A (Left)

P = positive radial rake angle
N = negative radial rake angle
W = wedge (double radial rake angle)
W' = wedge (negative radial rake angle)
B = blade (double radial rake angle)
B' = blade (negative radial rake angle)

B (Right)

B = blade (double radial rake angle)
B' = blade (negative radial rake angle)
P = positive radial rake
N = negative radial rake
C = crater on negative blade

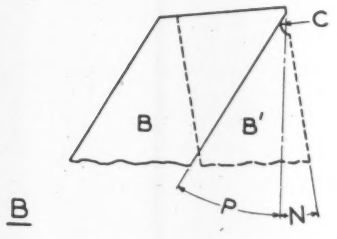
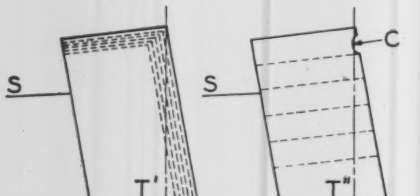


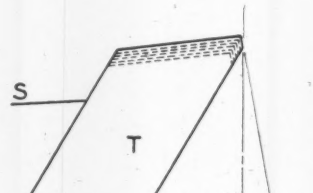
FIG. 16 DIAGRAM FOR COMPARISON OF CARBIDE CUTTING TIPS WITH DOUBLE RADIAL RAKE ANGLES AND NEGATIVE RADIAL RAKE ANGLES

(A—Section around cutting edge of face mill. Negative superimposed on negative-positive radial rake inserted solid-carbide blade. B—Double-radial-rake-angle design eliminates carbide which would be worn away on a negative-rake blade.)



B (Left)

C = crater
(S and N = same as in A)
T'' = negative rake inserted solid blade. Can only be ground this way. In removing crater, only 2–3 regrinds before resetting blade—uneconomical use of carbide.



A (Above, left)

S = periphery of cutter body behind carbide blade.

T' = brazed negative radial rake carbide tip; can be sharpened thus for economy in use of carbide tip, thickness decreases. Can also be sharpened as in B but after a few regrinds body must be ground or tip must be removed with application of heat and new tip brazed on. Percentage of carbide actually used in cutting is low with latter method.

N = negative radial rake angle.

C (Above)

T = double radial rake angle carbide blade showing maximum economy both in regrinding and use of carbide.
P = positive radial rake angle.

FIG. 17 CARBIDE TIPS WITH NEGATIVE RADIAL RAKE ANGLES AND DOUBLE RAKE ANGLES ILLUSTRATING CARBIDE LOSSES BY GRINDING

(Crater should be removed to provide a new sharp edge. Sections around cutting edge illustrated. Dotted lines represent successive regrindings, a total of 5.)

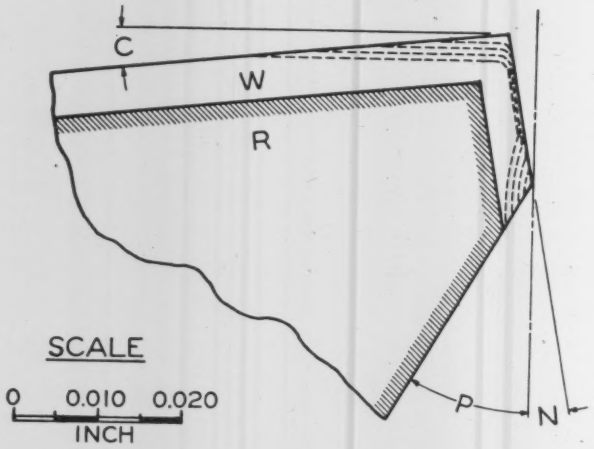


FIG. 18 ENLARGED SECTION OF CARBIDE CUTTING EDGE WITH DOUBLE RADIAL RAKE ANGLES, ILLUSTRATING SUCCESSIVE STAGES OF WEAR, AND ECONOMICAL REGRINDING

P = positive radial rake
N = negative radial rake
C = peripheral clearance angle
W = worn section of carbide cutting edge
Dotted lines show successive stages of wear
R = resharpened carbide cutting edge (shaded boundary)

NOTE: A completely resharpened edge can be obtained by grinding off approximately 0.005 in. on peripheral clearance and negative rake face.

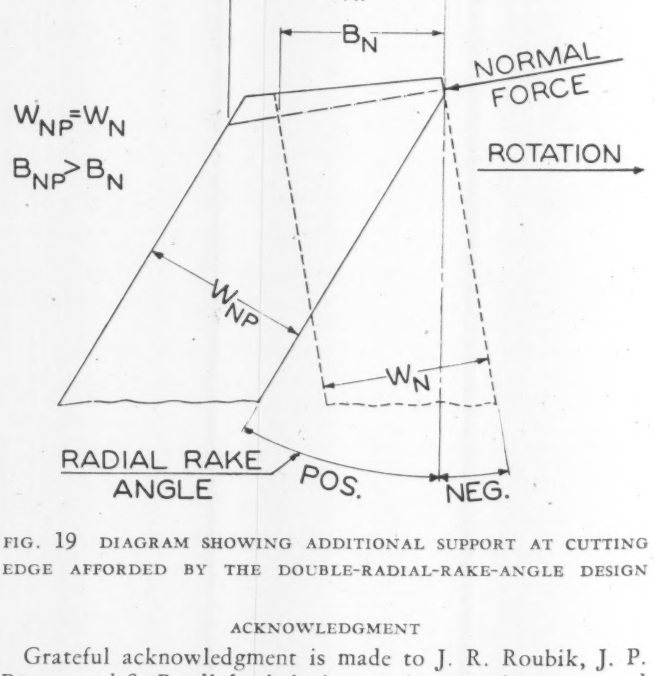


FIG. 19 DIAGRAM SHOWING ADDITIONAL SUPPORT AT CUTTING EDGE AFFORDED BY THE DOUBLE-RADIAL-RAKE-ANGLE DESIGN

ACKNOWLEDGMENT

Grateful acknowledgment is made to J. R. Roubik, J. P. Bunce, and S. Bandl for help in carrying out these tests and checking the manuscript; the photographic work was done by W. Skowronski, all of the authors' company.

Load-Compensating AIR BRAKES

By C. D. STEWART

DIRECTOR OF ENGINEERING, WESTINGHOUSE AIR BRAKE COMPANY, WILMERDING, PA. MEMBER A.S.M.E.

THIS year the air brake celebrates its 75th anniversary. Conceived at a time in this nation's history when the railroads were becoming a major factor in the expansion of the country, the air brake was one of the vital elements in the phenomenal growth of the railroads. Today, after 75 years of continuous physical growth and vast engineering advancement on the part of the railroad lines, their rolling stock, and the air brake, we find on reflection that this advancement has followed a rather definite pattern. That is to say, the power, efficiency, and weight of the locomotives have been continuously increased; the size, strength, and carrying capacity of the cars have been increased; and the air brakes have kept pace with the growing functional requirements associated with ever-increasing train lengths and weight.

Today, however, it would seem that we are on the threshhold of a new era in transportation in general and railroading in particular, involving marked changes in car construction and train speeds. Therefore, it is of particular interest at this time to examine the nature of further improvements in air-brake design to meet these material changes in railroad operation. In making this study it will be helpful to give some thought first to the nature of past improvements in the air-brake art and to consider if the same general trend in design is feasible and appropriate. If not, what should be the nature of the changes in order that the braking requirements of the railroad's new operation may be fully met?

SEVENTY-FIVE YEARS OF AIR-BRAKE IMPROVEMENT

The many and marked improvements in air-brake equipment throughout the 75 years of its existence have had for their primary purpose the safer and more reliable handling of trains of ever-increasing length, weight, and speed, and it is of special interest to note that the majority of these improvements have had to do with accelerating the brake application through the length of the train. The brake equipments have been and still are of a type that deliver the same braking forces whether the vehicles on which they are installed are empty or loaded. There are, of course, a few empty and load brake equipments in use today, but they are for the most part on special cars in isolated service.

Obviously, the operating results obtained with equipment of the single-capacity type are necessarily a compromise wherein the braking forces planned for the empty car are the highest that can be employed without bringing about serious difficulties of one character, in order that the braking forces on the fully loaded car may not be so low as to introduce serious difficulties of another character. Considering first the adverse results of using excessive braking forces on a light car, we find them to be either a likelihood of wheel sliding or intolerable train slack shocks, or both.

There is no simple means by which wheel sliding can be avoided, and therefore it is necessary to limit the maximum braking force to that which will not result in excessive wheel sliding under normal rail conditions. There are, however, several expedients which can be used to minimize train slack shocks and many of the improvements made in the air-brake operating devices throughout the years have had to do with one or more of these expedients. One of these has been the perfecting from time to time of the transmitting features of the triple valve, whereby the time of application of the brakes between the front and rear ends of the train has been greatly shortened. Another is the control of the rate of development of the braking forces, particularly during the first stage of brake application. A third involves the provision of more uniform braking forces throughout the train.

The ways in which faster transmission time has been accomplished constitute some of the high lights in the development of the air brake and are worthy of brief comment, not only as a matter of general interest but because the possibility of limitations of further development in this direction are pertinent to this discussion. The original success of the air brake was due, in large measure, to the fact that with its use the brakes could be applied throughout the trains very much faster than had been possible with any other form of brake.

By the use of the simple straight air brake, trains of 15 cars were controlled satisfactorily for the first time; this was in 1869. The success of this operation stimulated the desire to haul longer trains, and this desire was realized with the production of the first plain automatic brake in 1873. Because the application of the automatic brake is faster than that of the straight air brake, it was possible to increase the train length from 15 to 25 cars. In 1887 the Master Car Builders' Association expressed the desire to haul trains of 50 cars, and invited any company that so desired, to supply a trial set of brake equipments that would control that length of train without severe slack shocks. During the next 2 years, eight different companies submitted for test at least a dozen designs of brakes. Not one of those submitted met the stipulated requirements. In fact, after the first few trial runs, some of the manufacturers resorted to electric control of the brakes in an endeavor to avoid severe slack action.

As the road trials were drawing to a close, without any satisfactory brake being demonstrated, Mr. Westinghouse conceived the idea of speeding up the transmission of the brake application by causing each triple valve to create a local discharge of brake-pipe pressure. This local reduction augmented the reduction at the brake valve on the locomotive and thereby relayed the desired action serially throughout the train. The valve embracing this feature came to be known as the "quick-action triple valve," and by its use 50-car trains were controlled very satisfactorily. This quick-action feature was operable only for the emergency application of the brakes, and it was soon realized that if this same local venting feature could be added for the service application, still longer trains would be made possible.

Accordingly, after extensive research the "quick-service feature" was developed and introduced in 1905. By means of this improvement, train lengths were increased to 80 cars. Finally, after the most intensive research yet undertaken, the quick-action and quick-service features were materially improved and, in 1933, the AB valve containing these improved features was placed in service on the American railroads. In this valve the quick-action transmission speed was increased approximately 50 per cent over that of its predecessor. This transmission speed is close to that of sound which, in the light of today's knowledge, appears to be the ultimate. Thus we see that during 75 years the speed of pneumatic transmission of the brake action through the train has experienced five major advancements, and the transmission speed now employed appears to be the maximum attainable.

The second expedient, that of controlling the rate of generating the braking forces, is a relatively new function and must for obvious reasons, be limited in its application.

Contributed by the Railroad Division and presented at the Annual Meeting, New York, N. Y., Nov. 27–Dec. 1, 1944, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

The third expedient, that of providing more uniform braking forces, is the one that has had the most limited application of all three to date. It offers great possibility for expansion during the next transportation cycle, comparable to that just cited for the transmission function.

LIGHTWEIGHT CARS CREATE NEW BRAKING REQUIREMENTS

It is the opinion of many railroad men that, for reasons of competition, the speeds of certain types of freight trains will be increased, and for reasons of economy there is justification for careful consideration of the use of lighter-weight cars.

It would be a natural first impulse to assume that the present single-capacity brake would be entirely suitable for the new lightweight cars. If this assumption were to be questioned it would be logical to ask why do the new lightweight cars require a different basic type of brake equipment from that which has been apparently satisfactory for 75 years for the heavier cars. The answer to this question will be clear if we look at the present basic type of brake equipment in the light of changes in car construction over the years.

Freight cars at first were all wood; later steel underframes were substituted, and still later many cars were made entirely of steel. And yet, throughout all these changes, the gross-to-tare ratio of these cars remained in most cases substantially unchanged. It follows that throughout this same period the basic braking ratios for the empty and loaded freight cars held closely to the same spread. Years of experience with these maximum and minimum braking-ratio limits shows that with the maximum limit for the empty car, wheel sliding has not been excessive and train slack action has been tolerable; and, with the minimum limit for the loaded car, the control of trains on grades has been safe.

For some time now there has been a tendency to increase materially the load-carrying capacity of certain cars by means that only slightly increases their empty weight. Hence in order that the loaded braking ratio may not be lowered, permission was granted by the brake committee of the A.A.R. to raise the empty braking ratio from 60 per cent to that percentage necessary to insure a safe minimum ratio but in no case might the maximum empty braking ratio exceed 75 per cent. In this decision will be recognized a further compromise made in an effort to keep the brake equipment in its simpler form. This increased spread in braking ratio between empty and loaded cars obviously increases the problem of controlling train slack action.

During this same interval of time the locomotive weight has been greatly increased, and the size of the tenders and their load-carrying capacity have increased in even greater proportion. As a result, we have a situation wherein the gross-to-tare ratios between the cars in the train and between the train as a whole and the locomotive are continuing to grow. Picture a heavily loaded train drawn by such a locomotive having a temporary low fuel and water supply. Under these conditions, the braking effort on the train will be a minimum, and that on the locomotive will be a maximum, thus setting up a condition for creating heavy strain between the locomotive and the train that can produce shocks harmful to the lading.

This condition is sufficiently common that it is widespread practice for the engineer to "work steam" when first applying the brakes in order that the effectiveness of the locomotive brakes will correspond more nearly to that of the train brakes. On the other hand, the reverse of this condition is obtained when the cars of the train are empty and the locomotive tender is loaded to capacity. Because of the skill on the part of the locomotive engineers controlling the locomotive's braking forces whenever this is possible, and because of a new feature incorporated in the 8-ET and the AB brake equipments that has for its purpose the control of the build-up of brake-cylinder pressure during emergency applications, the slack adjustment is controlled.

In spite of the expedients just cited, it is obvious that the wide spread in braking ratios is not ideal. However, operating troubles have not been sufficient to cause too much concern with existing cars and locomotives.

Now, however, with the railways planning to meet the anticipated keen competition in the transportation field following the war's end, by the use of lighter-weight cars and higher operating speeds, the resultant, additional spread in braking ratios on the lightweight cars will be beyond the capacity of the single-cylinder brake equipment. This is true both from the standpoint of holding the maximum and minimum ratios within the present acceptable value and from the standpoint of stopping the trains of such lightweight equipment from higher speeds within most present-day signal spacings. Signals have in most cases been spaced on the basis of the stopping distance of trains of the class that will be most likely operated at the higher speeds in the future.

We have stated the situation that prevailed with respect to railroad operation and air-brake development from the conception of the air brake to the present time. We have shown that in the development of both cars and brake equipment we have arrived at the point where a change in the gross-to-tare ratio of the cars, such as results from the use of lightweight materials for the construction of an otherwise conventional car, will require a different form of brake. Having set forth these conditions, we are now ready to consider the manner in which air-brake equipments may be designed in order that they may control the freight trains of the immediate future safely and efficiently.

DEVELOPMENT OF NEW-TYPE VARIABLE-CAPACITY BRAKE

These new conditions will require more braking force for the loaded car but, as we have shown, the empty-car braking force must not be raised above its present maximum. Careful study of this situation clearly shows that it can best be met by the use of a variable-capacity brake of a type that automatically compensates for an increase in the loading.

This new type of equipment employs a double brake-cylinder arrangement to provide a maximum braking force of, let us say, 60 per cent of the lightweight of the car, a minimum braking force for the fully loaded car of between 20 and 30 per cent, and an intermediate breaking force rather close to the maximum for cars partially loaded, Fig. 1. Because in the high-speed type of freight, the cars are likely to be loaded to some intermediate capacity, this latter feature will be beneficial in offsetting the increased energy that results from the increase in train speed, it being remembered that this energy increases as the square of the speed.

Let us first note the effect on braking ratio brought about by reducing the weight of the car. Examination of three typical weight classes will be sufficient to show the marked differences in braking ratios with a single-capacity brake and with the load-compensating brake, Table 1.

Next let us consider the stopping distance of a train of present standard-weight cars braked with the present standard single-capacity brake, and a train of proposed lightweight cars, equipped first with the same type of brake, and then equipped with the load-compensating brake. For a given speed and lading, the stopping distances will be in substantially direct proportion to the braking ratios of the cars. If the first train stops in distance X, the second train will run $X + 12$ per cent, about 12 per cent further, and the third train will run $X - 30$ per cent. Saying this another way, the third train can operate at 20 per cent higher speed and yet stop in the same distance.

Now this illustration has to do with a change in the braking equipment on the cars of the train only. It will be of interest to consider the benefits to be gained from the use of similar modified equipments on the tender and the engine of the locomotive. On these two elements of the power unit, different

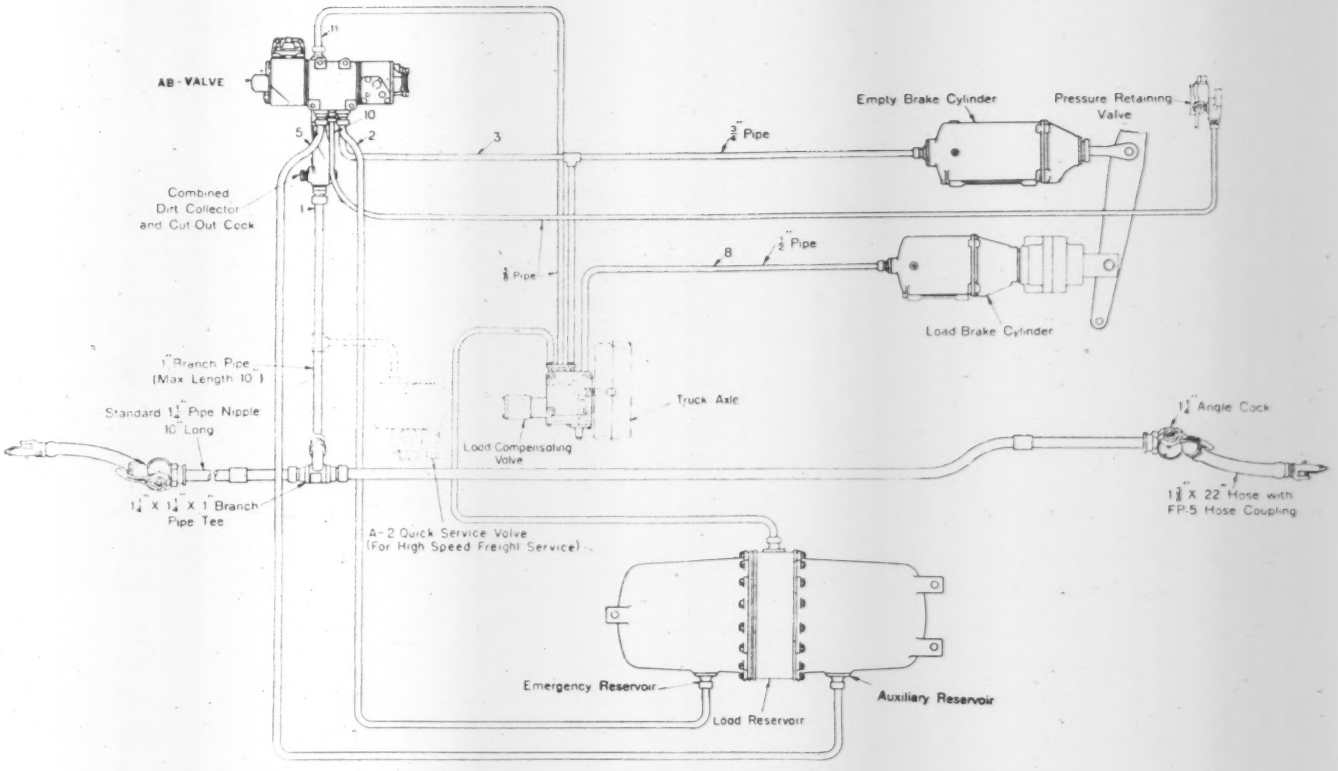


FIG. 1 LOAD-COMPENSATING BRAKE EQUIPMENT

(Load-brake parts are added to the conventional AB equipment to form this new brake equipment.)

means for regulating the braking forces must be employed as well as a different means for measuring the conditions that establish the need for the change.

Tender Brake Equipment. Discussing first the tender brake equipments and the braking forces that are available on a standard equipped tender of today and what braking forces would be available with the use of the proposed equipment, a typical modern tender for a freight locomotive weighs about 147,000 lb when empty, and 390,000 lb when loaded with 22,000 gal of water and 30 tons of fuel. The gross-to-tare ratio is therefore 2.66 to 1. The average tender is braked at about 100 per cent of its lightweight. It will be apparent that when this tender is associated with a fully loaded train, even the lowest braking force is much higher than that on the cars. However, when it is associated with an empty train, there is only one value of water and fuel load wherein the braking ratio will be the same as that of the train.

It is of further importance to point out that, whereas the train load is constant for its entire journey, the tender loads fluctuate continuously. It is apparent, therefore, that if the braking ratio on the tender were to be held substantially constant despite the fluctuating load, then the matter of further adjusting the braking force to correspond closely to that of the train would be a relatively simple matter. Since the means for making this latter adjustment is a function of the engine equipment, we will discuss that in conjunction with the engine equipment.

Locomotive Brakes. As to the braking forces on the engine portion of the freight-locomotive unit it is a frequent practice to omit brakes from the nondriving wheels and limit the braking force on the drivers to a rather nominal amount.

The engine as well as the tender braking ratio will coincide with that of the train for one condition of loading only. Furthermore, the locomotive weight does not fluctuate. Therefore, it is a relatively simple matter to have the braking ratio on the locomotive adjusted to correspond with that of the train.

This being so, what are the benefits derived from providing locomotive braking forces more in keeping with those on the train? These benefits vary with operating conditions, but in general it is safe to say that stopping distance will be improved, slack action will be less, and the locomotive engineer will not attempt to compensate for unequal braking through the expedient of keeping the throttle open during braking, or holding the engine brakes released. Examples of the stopping distance and difference in drawbar pull under the two methods of operation will be of interest.

Assuming first the conventional train of 75 cars previously cited and the engineer "working" steam in accordance with widespread practice, the drawbar pull between the locomotive and the train will be in the order of 15,000 lb. Assuming next the train of lightweight cars, but leaving all other conditions unchanged, the drawbar pull will be 13,000 lb, and when the load-compensating brakes are substituted, the drawbar pull will be increased to 30,000 lb. Now, to the locomotive brake equipment of this third train add the load-compensating brake to the tender and the brake-

TABLE 1 COMPARISON OF BRAKING RATIOS

Lightweight, lb	Axle load limit, lb	Gross-to-tare ratio	Empty-brake ratio, per cent	Single-capacity, 10-in. equipment, per cent	Load-compensating brake; typical optional percentage of load-brake ratio
50000	169000	3.38:1	75	22.8	50
			60	18.5	
40000	169000	4.2 : 1	75	17.7	44
			60	14.2	
30000	169000	5.92:1	75	13.3	33
			60	10.8	

force-adjusting relay to the engine and thereby adjust the locomotive braking forces to correspond with those of the train. The drawbar pull will be reduced to an insignificant amount and the stopping distance will be slightly lowered.

The figures just cited are for a loaded train. The manifest train is of interest also because it is the type of train that will likely be operated at higher speeds. Comparing the relative stopping distances of these manifest trains under similar conditions discloses a similarly interesting comparison.

PRINCIPLES INVOLVED IN ADJUSTING BRAKING FORCES

The first principle established was that the mechanism for setting the car braking ratio to correspond with the car lading must be operated automatically, for obvious reasons; and the setting must take place when the car is stationary, and then the measuring device must be out of engagement with any part that can vibrate as a result of the car's motion. This is for the dual purpose of avoiding a false registration and of avoiding unnecessary wear. The mechanism for setting the tender braking ratio must on the other hand be in continuous registration with the weighing device because of the fact that the tender weight varies continuously. This adjusting mechanism must likewise be automatic.

The mechanism for setting the engine braking ratio must, however, be manual because there is no simple means for registering on the locomotive the load on the cars. The manual adjustment in this case is not a difficult one to make, and, since it needs to be made but once per trip, it is simpler than most of the tasks performed on the locomotive by the engineer in preparation for his departure.

Having shown what it is desirable to accomplish by new air-brake functions, we will state briefly how these functions are added to the present standard brake equipments for the three types of vehicles involved. The weighing and adjusting devices for both the car and tender brake equipments are automatic in their operation. For the car the weighing mechanism performs its function once only at the time the car is being loaded or unloaded. The weighing mechanism is then disengaged and thereby the car-body vibration en route cannot give a false reading nor wear out the equipment prematurely. It is easy to limit the weighing cycle in this manner by taking advantage of the fact that during loading and unloading operations the air pressure in the brake pipe is vented. When the locomotive is coupled to the car and the air-brake equipment is being charged, the weighing mechanism is caused to function during the rise in air pressure from atmospheric to 35 lb. Any pressure above this value automatically disengages the weighing mechanism. During the interval that it is gaging the weight of the car, it adjusts the load-compensating valve to the proper ratio, and, when the weighing mechanism is disengaged, the compensating mechanism is locked in its proper setting.

During braking operations, the "empty" brake cylinder operates first and, if the car is empty to about one fourth loaded, it is the only brake cylinder to operate. As the load is increased from one quarter of capacity to full load, the "load" brake cylinder follows the "empty" brake cylinder in its application of the brakes and adds the correct braking force to that of the empty cylinder, to the end that the braking forces on the car are uniform within practical limits throughout the range of loading, Fig. 2.

The brake equipment on the modern high-capacity tenders can be of a type very similar to that just described for freight cars. Like the freight cars, the spring deflection may be used to adjust the braking forces in accordance with the constantly changing load of fuel and water. A better method is to use a mechanism for weighing the water. Preliminary investigation of this means indicates that it is very accurate, and it is easier to do mechanically than to weigh by spring deflection because of the wheel arrangement employed on the large-capacity tenders. Because the braking forces for a loaded tender will be high, there is a distinct advantage in using the high main-reservoir pressure for braking purposes. Fortunately, this is easily accomplished from the locomotive air supply, and the resultant reduction in brake-cylinder sizes is advantageous.

The weight of a typical locomotive unit suitable for the type of service under consideration is in the neighborhood of 780,000 lb; the weight being about equally divided between the engine and the tender. The weight of the engine portion of the locomotive is substantially constant and therefore a given brake-cylinder pressure will develop the same retarding force at all times. It follows that, under the extreme conditions represented by a long empty train in one case and a long loaded train in another case, there is a great variation in the effect of the locomotive's rate of retardation on train slack. If therefore the brake-cylinder pressures are varied in accordance with the change in weight of each train, the retarding forces on the locomotive would then correspond more nearly to the average of the train.

The change in braking ratio on the locomotive is readily accomplished by a manual adjustment of the pneumatic de-

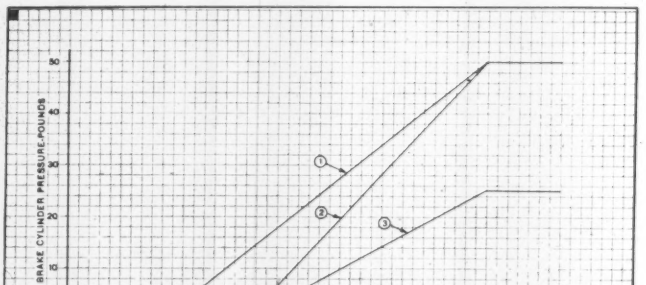


FIG. 2 TYPICAL BRAKE CYLINDER CURVES

(1, Empty-brake-cylinder pressures versus brake-pipe reduction for any load condition. 2, Load-brake-cylinder pressures versus brake-pipe reduction with car fully loaded. 3, Load-brake-cylinder pressures versus brake-pipe reduction with car partially loaded.)

vices involved. It can be in the form of an exceedingly simple manually set pneumatic relay. This relay is of the well-known differential type in which air pressure on the primary side of the relay causes the development of one of a choice of several pressures on the secondary side, depending upon the manual setting. With this arrangement, the locomotive engineer on learning the average weight per car of his train and knowing that it is a high-speed manifest train or a lower-speed heavy-commodity train, will make the manual adjustment of the differential relay for the purpose of regulating the braking forces correctly for the particular run.

CONCLUSION

So thus we conclude with the conviction that the single-capacity brake equipment has served its purpose well during the 75-year cycle of power braking and a period of railroading marked by a very sturdy growth. We now appear to be entering a new cycle in which newer forms of transportation are asserting themselves and new materials make possible marked and desirable changes in the construction of railway cars.

Under these new conditions, it would seem that the next logical step is in the direction of load-compensating brakes for freight cars and locomotives, thereby permitting tomorrow's trains to move at shorter intervals with heavier loads at higher speeds with the same degree of safety.

FEEDWATER TREATMENT *for* LOCOMOTIVE USE

Some Practical Aspects

By T. W. HISLOP

WATER SERVICE ENGINEER, NEW YORK CENTRAL SYSTEM

FOR many years officials of the New York Central System have been interested in the improvements to be obtained from the use of chemical treatment of locomotive boiler waters. Before entering into a comprehensive program, careful thought was given to the various aspects of operation from the standpoint of economy to be obtained and increased utility of locomotives that might be effected. Careful studies and analyses of the costs of operation were made in the various territories which have widely different natural water conditions, before a decision was rendered in the procedure to be followed.

LOCOMOTIVE BOILER-WATER SUPPLIES

The locomotive water supplies on the New York Central System are relatively good in comparison with those on some of the other railroads, and prior to 1924 water-treating practices varied widely in different territories. A few lime-soda water-softening plants had been built on certain divisions, but for the most part reliance was placed upon manually applied tender-tank treatment.

On one short division, however, seven of the nine water stations were equipped with water-softening plants. The hardness of the water at these nine stations averaged 30 grains per gal. Before this treatment was installed locomotives operating on this division required tube- and firebox-sheet replacements within 6 to 8 months, owing to heavy dense scale and pitting.

After treatment, which by the way was not complete, the life of tubes and firebox sheets was extended about threefold. Relatively, this was a vast improvement but scale and some corrosion still persisted, with boiler maintenance still on the excessive side.

EARLY CONSIDERATION OF LOCOMOTIVE-BOILER WATER TREATMENT

Up to this time there had been sincere differences of opinion not only as to the best form of water treatment but as to whether water treatment of any kind could be justified economically. In 1924, therefore, an investigation was undertaken to ascertain (*a*) what water supplies required treatment, (*b*) what kind of treatment should be installed, (*c*) what the treatment would cost, and (*d*) what savings could be expected.

This necessitated a knowledge of the consumption and quality of each water supply as well as the cost of boiler maintenance and fuel consumption. After many months these data were collected, the report revealing that for each territory, boiler maintenance and fuel consumption were directly related to the quality of the water and increased as it became harder.

During this same year, 1924, the water-service committee of the American Railway Engineering Association (A.R.E.A.) reached the conclusion that for each pound of incrusting solids allowed to get into a locomotive boiler the loss to the railroad would amount to at least 13 cents.

ESTIMATED SAVINGS CREDITED TO BOILER-WATER TREATMENT

A comparison of the losses, as disclosed by the investigation of the New York Central System, and those derived by applying the A.R.E.A. formula, revealed a remarkably close accord. The A.R.E.A. formula produced losses slightly less than the New York Central System study, which justified its use for conservative calculations of savings due to boiler-water treatment.

As a result of this investigation 160 water supplies were recommended for treatment. The gross saving effected thereby figured approximately $1,400,000 per year. To treat these water supplies, the cost including chemicals, labor, interest, and depreciation on equipment amounted to roughly $400,000. Thus a net saving of approximately $1,000,000 per year was anticipated.

ADOPTION OF WATER-TREATING PROGRAM

These figures prompted adoption of the program for treating the water supplies as recommended. Before doing so it was deemed advisable to treat the waters fully on the afore-mentioned division to ascertain the maximum economies expected before proceeding with the remainder of the program.

Lime-soda softeners were employed at these water stations and full treatment was administered. However, before this was done it was arranged to have the locomotive boiler blowoff valves equipped with levers for cab operation so that on-the-road blowing could be done in addition to adequate terminal blowing to prevent foaming. In due time it was apparent that the results were comparable with those as predicted. In this report of investigation, 87 lime-soda softeners and 73 wayside treaters employing compounded chemicals were recommended for treatment.

After completion of the experiment with lime-soda treatment it was decided to prove the merits of wayside treaters. The Ohio Central Division was selected for this experiment as the 21 waters in use averaged 18 grains per gal of hardness. At first the treatment was only partial, as it was believed at that time to be ample with this form of treatment. This resulted in considerable improvement, for the amount of scale formed within boilers was greatly reduced, and nearly all pitting and corrosion were eliminated. However, after 6 to 8 months with this treatment mudbanks were formed between boiler tubes, and it was necessary to remove a number of these tubes in order to clean out this accumulation. A 20 per cent increase in the treatment resulted in a longer period of time between formation of such mud banks and also lessened the amount of scale formed.

It was then decided to treat these waters fully by the wayside method. Before doing so, however, it was recommended that cab-operated blowoff facilities be installed on all locomotives operating on this division as the terminal blowdown employed

Contributed by the Railroad Division and presented at the Annual Meeting, New York, N. Y., Nov. 27–Dec. 1, 1944, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

at that time would not be sufficient for satisfactory boiler operation with full treatment and on-the-road blowdown would be necessary.

About this time the depression of 1931 was at its peak and it was therefore decided to postpone this program. Eventually, full treatment was applied to five locomotives operating in this territory, introduced in the tender tank manually, in order to determine the maximum economies obtainable therefrom. This test proved very successful. Washout periods were extended from 6 to 30 days, time between shoppings doubled, and running maintenance became negligible for the locomotive boilers so treated.

The results of these experiments proved conclusively that full treatment was well worth while. In 1935 authority was given for the extension of treatment to all territories of the New York Central System.

At the present time a total of 253 water supplies are treated, employing 34 lime-soda softeners, 78 liquid proportioners, and 141 by-pass feeders. The present estimate indicates that a net saving of over $2,500,000 a year is being realized from water treatment on the New York Central System.

OTHER BENEFITS TO BE DERIVED FROM WATER TREATMENT

If consideration is given to the intangible benefits derived from extended washouts, less boiler maintenance, and the greater mileage realized between shoppings which results in greater availability of power, the saving would far exceed this figure. Washouts have been extended in most cases from 6 to 30 days. Mileages between shoppings have increased over 100 per cent.

Those unfamiliar with locomotive-boiler-water treatment might not visualize the numerous factors entailed in the realization of the foregoing results. Therefore, these are briefly outlined in the following:

SELECTION OF LOCOMOTIVE-BOILER WATER-TREATING EQUIPMENT

Lime-soda softeners, wayside liquid proportioners, and by-pass feeders are utilized for proportioning treatment to water supplies. Their selection depends on the quality and quantity of the individual water. Waters with high hardnesses, or those with relatively low hardnesses and large consumptions, would be best served by a lime-soda softener; the advantages are cheaper treatment plus removal of practically all hardness, together with removal of any organic pollution, and of suspended solids contained in the raw water. This means that there will be less suspended or precipitated solids within the boiler waters, assuring cleaner boilers with less blowdown required.

These advantages will justify the expenditure for necessary equipment, such as large settling tanks, solution tanks, proportioning equipment, housing, and space required for this installation.

Where sufficient savings are not produced to justify the expenditures for lime-soda softeners, liquid chemical proportioners or by-pass feeders are employed. These installations necessitate housing for chemical-solution tanks, proportioning equipment, and chemical stock. The by-pass feeders, employing compressed chemical compounds, can be installed within the frost box or valve pit of water-storage tanks and will need only housing for the chemical stock.

CONTROL OF LOCOMOTIVE-BOILER-WATER TREATMENT

All treating facilities are arranged so that the prescribed chemical charges are made on a time basis. In certain plants recharging or making up new solutions may have to be done two or three times each 24 hr, while in smaller plants with less consumption, the chemical charge may have to be made only every other day. The chemical dosages are administered by men of different departments whose regular duties necessitate their presence in the vicinity of the treating plants involved. Usually the lime-soda plants require the full-time services of an employee but at some plants only part-time services are required, depending upon the water characteristics and location of the plant.

Success of locomotive-boiler-water treatment depends on the addition of the prescribed chemical dosages to all waters without interruption. This necessitates frequent checking of all water supplies, which is accomplished by analyzing samples of raw and treated waters sent in periodically from all water-treating plants to a control laboratory. Further check is made by analyzing samples of locomotive-boiler waters which are also sent in periodically to the control laboratory, as well as the samples obtained by water-service inspectors during their frequent visits to the locomotive terminals and water-treating plants.

Analyses of the boiler-water samples give the over-all picture of treatment for the territory traversed by the locomotives. If they disclose incorrect treatment the respective territory is visited immediately by an inspector and corrective measures prescribed.

Uninterrupted treatment therefore depends upon the full co-operation of all those directly involved and full maintenance of the chemical proportioning equipment, as well as sufficient chemical stock to assure an uninterrupted supply.

LOCOMOTIVE "BLOWDOWN"

The remaining phase of boiler-feedwater treatment is the control of the impurities contained in boiler feedwater which are acted upon by heat and water treatment within the boilers, changing their character from scale-forming to nonscale-forming materials. Portions of these solids are precipitated as a sludge while the dissolved solids, largely sodium compounds, continue to concentrate in the boiler water as the feedwater is added to make up for evaporation. If this process is allowed to continue without any corrective action the boiler water would eventually foam with attendant delay to operation and increased maintenance of the equipment. An adequate system of blowdown becomes a necessary part of the water-treatment program to eliminate these solids. It has been demonstrated that proper blowdown procedure will remove sufficient sludge and dissolved solids to prevent foaming and excessive build-up of sludge within boilers. Blowdown on the road and at the terminals is arranged to control this condition.

The larger part of the road blowdown on the New York Central System is done by an "automatic continuous" blowdown arrangement. This arrangement consists of a small orifice whose water discharge from the boiler is controlled by an automatic valve actuated by the operation of the feedwater pump. The quantity discharged is determined by the size of the orifice and the boiler pressure employed. This arrangement is supplemented by manual cab-operated blowdown on those divisions where more blowdown is required or when adverse water conditions arise.

This combination of blowdown arrangements is ideal for locomotives operating on the New York Central System and traversing different territories for which the required blowdown will vary for each division.

LOCOMOTIVE FEEDWATER TREATMENT CONTRIBUTION TO THE WAR EFFORT

In conclusion it might be added that the New York Central System has been fortunate in having completed its locomotive boiler-water-treatment program before the present war started. The benefits therefrom have contributed to the increased utilization of the steam locomotives by keeping them out on the line hauling passenger and freight trains instead of being held out of service for boiler work, during the present emergency.

Developments in the FREIGHT-CAR TRUCK

By ROBERT BOYD COTTRELL

CHIEF MECHANICAL ENGINEER, AMERICAN STEEL FOUNDRIES, CHICAGO, ILL. MEMBER A.S.M.E.

FREIGHT-car-truck development may be divided, broadly, into two phases, (*a*) design and (*b*) testing.

Sound engineering design of freight-car trucks requires a basic knowledge of the art and particularly a broad background of the fundamentals of foundry practice, metallurgy, strength of materials, service performance, operating conditions, spring design, and proper spring control. In addition, frequent inspections of existing trucks that are in service under varying operating conditions are essential. This is the only reliable way data can be obtained regarding mileage, wear, and proper functioning of parts, spring arrangement, and condition of spring control devices.

Such inspections will demonstrate the suitability of certain forms of design and construction or indicate the need for corrective measures. After all, freight-car trucks are designed for a definite purpose, and no better proof is known to the author of their utility and proper construction than years of satisfactory service.

Of equal importance to proper design in truck development is adequate testing. Regardless of how attractive an idea or design may appear on paper, the final answer is not available until after sufficient mileage in actual service has demonstrated its suitability. To insure against the possibility of unsatisfactory service performance, facilities for testing the truck and all of its parts properly and quickly are necessary. With adequate equipment available and a knowledge of its relation to service requirements, not only may individual designs be tested, but a background of valuable data acquired, so necessary for the advancement of the art.

TESTING FREIGHT-CAR TRUCKS

The testing of freight-car trucks may readily be separated into two general types; (*a*) structural testing, and (*b*) performance testing.

Structural testing comprises checks to determine strength of the various individual parts or combination of parts. Completely equipped physical, chemical, and metallurgical laboratories, with competent personnel, are needed.

The physical laboratory is concerned with determining whether the physical properties of the parts are in accordance with specified requirements. This work requires the making of tension and compression tests and includes the static testing of full-size bolster and side-frame castings to determine deflection, set, ultimate load, type and location of failure, in accordance with Association of American Railroads (A.A.R.) prescribed procedure.

Dynamic or fatigue testing of a complete side-frame casting also affords valuable data, as do static calibrations and dynamic bounce tests of spring-suspension systems. Wear-testing of rubbing parts, together with visual and dimensional checks to see that drawing and specification requirements are met, should not be overlooked.

The responsibility of the chemical and metallurgical laboratories is to assure that the composition and heat-treatment of each part is satisfactory. Also, like the designing engineer, they should continually be striving further to improve the product. New heat-treatments of existing steels, or different compositions having definite advantages for application to freight-car trucks, should be thoroughly explored and developed.

Assuming the truck has been designed, manufactured, and structurally tested, we come to the very important question of performance. There were originally certain space and dimensional limitations to be observed, and certain operating conditions to be met. Operating requirements may be designated as follows:

(*a*) Regular everyday freight-train service with corresponding speeds.

(*b*) High-speed merchandise service in which the freight car is operated in passenger trains or in special trains with speeds up to 90 mph.

(*c*) A combination of both.

No better way is known to the author of testing truck performance than actually placing it under a car and subjecting it to the operating conditions under which it is designed to function. To investigate performance thoroughly and adequately, suitable equipment and a place to operate it properly are required. An ideal setup for such work would consist of two standard A.A.R. boxcars equipped to provide accurate and completely detailed observations and records of freight-car-truck performance.

One of the cars should be equipped with trucks of known performance and the other one with experimental trucks under investigation for comparison of performance under similar conditions of track, speed, and lading.

For high-speed testing it is best for the two cars to be combined with a high-speed locomotive and three standard passenger-type cars to form a test train complete in itself. The passenger-type cars are desirable because they are equipped with regular passenger-type trucks and act as buffers to separate the test cars, thus eliminating outside influences as much as possible. For operation in regularly scheduled passenger trains, the two test cars may be coupled together and placed at the head end next to the tender. If truck performance is to be investigated at regular freight-train speeds and operating conditions, the two test cars are coupled together and placed either at the head end next to the tender or preferably at the rear end just ahead of the caboose. If available, a caboose may be placed ahead of the two test cars to isolate them as much as possible from the rest of the train.

Proper and adequate instrumentation is necessary if the full value of any investigation is to be realized. Merely placing a freight car in a train and having someone ride it does not, in the author's opinion, represent adequate instrumentation. Such tests may be influenced by the personal element but particularly the operator's experience and impressions cannot be evaluated numerically and become permanent records for future comparison. In this the author is in agreement with the ideas of K. F. Nystrom, mechanical assistant to the chief

Contributed by the Railroad Division and presented at the Annual Meeting, New York, N. Y., Nov. 27–Dec. 1, 1944, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

operating officer, C.M.St.P.& P.R.R., as stated in a recent paper.[1]

All variables that might affect results should be kept to the absolute minimum. Instruments for recording accelerations, it is believed, should be mounted on supports anchored directly to the body bolsters, thus eliminating any errors due to floor conditions and assuring accurate comparison at all times of the performance of the trucks under both cars. Duplicate sets of instruments should be provided in each end of each car directly over the trucks. Such an arrangement provides data of riding qualities of the trucks independent of car-body conditions and construction. If the question of car-body effect on riding qualities is introduced, then it may be desirable to supplement the instrumentation by additional ones on the floor of the car at the center.

It is necessary that all charts be marked or coded simultaneously for comparison purposes. A system of dots and dashes representing mileposts, stations, crossings and curves, is very helpful in reviewing the results of the tests. In addition, a log of each run should be kept and include data as to speed at each milepost or station, a record of the code markings and counter readings at designated locations, as well as all other information of value and interest.

It is obvious that while instruments are indispensable in measuring riding quality and performance, trucks must also be observed in action if complete data are to be obtained. For this purpose large clear-vision windows should be strategically located in the floor at the corners of each car. They will permit observation of the trucks throughout the tests and notes regarding their action at various speeds should become a part of the record.

The test cars should be arranged so that runs may be made under all conditions of loading from minimum to maximum amount permitted at rail. Ordinarily, runs at the maximum and minimum rail loads which the cars may encounter in service are sufficient to determine truck performance. However, runs at intermediate loads may be made to check action and riding quality under such conditions.

The type and condition of track over which the test cars are operated are of extreme importance. Track suitable for this purpose should include a smooth portion representative of high-grade main line in good condition. There should also be a stretch of rougher track typical of secondary main line not in the best of condition. A number of moderate curves with one or two of the sharper variety, together with some switches, crossovers, rail and highway crossings, are desirable. The test run should be long enough to permit adequate observations and recording under all conditions encountered. A definite speed schedule should be set up and maintained so that tests on successive days may be compared. If the truck under the base car is not altered or modified and has a fairly constant performance under different speeds, it will compensate somewhat for nonuniform test speeds, but should not be depended upon to take care of major variations.

Accurate wheel contours should be maintained to prevent the introduction of another variable. Concentricity, also, is important and should be maintained. For high-speed operation, the journal-box packing and lubrication should be given preferred attention. A.A.R. waste-retaining ribs in the boxes are of real help in preventing hotboxes and are well worth while. Rough riding trucks generally result in waste disturbance in the boxes, with higher temperatures and possibility of waste grabs. As trucks with longer spring travel and easier riding qualities are being placed in service in increasing quantities, a record of hotboxes of such equipment compared to regular types, would be of interest. As hotboxes are rather expensive occurrences, it may be possible that a material reduction in their number would more than offset the additional cost of the longer-travel springs. It is believed that such a study would be well worth while.

[1] "Future Freight-Car Trucks," by K. F. Nystrom, 1943 Year Book, Car Department Officers' Association; published in *Railway Mechanical Engineer*, vol. 118, 1944, pp. 204–206.

DESIGNING A SUITABLE SPRING-SUSPENSION SYSTEM

One of the most serious and difficult problems in truck design is the one of proper spring-suspension system to take care of the wide variation in load requirements. The system must, necessarily, have sufficient capacity to take the maximum rail load specified and at the same time should provide satisfactory ride under minimum load conditions. When it is considered that the load on one spring system of a 50-ton boxcar may vary from approximately 7800 lb under empty-car conditions to about 40,000 lb when fully loaded, the magnitude of the problem is apparent. It has been thoroughly proved that it is possible to design a freight-car truck which will give a satisfactory performance for all conditions from empty car to full rail load and at speeds up to 90 mph or above; however, the riding qualities must necessarily be a compromise. To provide a freight-car truck with a spring system suitable for the full rail load of 169,000 lb and properly controlled to prevent resonance, means that the spring group must be stiffer than would be the case if the maximum lading was restricted, say to 145,000 lb, 136,000 lb, or even lower.

In addition to the load variation that is encountered there is also the problem of speed to be considered. The A.A.R. high-speed tests of 1939 demonstrated rather thoroughly that below operating speeds of 60 mph the problem is mainly one of resonance, while at speeds in excess of this it is the dynamic effect of track irregularities. Subsequent tests with which the author has been connected also demonstrated this, and thus confirm the A.A.R. results.

FUNDAMENTALS OF FREIGHT-CAR-TRUCK DESIGN

From the results of the A.A.R. high-speed tests of 1939 and subsequent work, some fundamentals of freight-car-truck design for high-speed service have been demonstrated. They are as follows and not necessarily in the order of their importance:

Long-Travel Springs. In order to cushion properly the high-velocity impacts, long-travel soft springs are necessary. It has been found that about $3^3/_4$-in. travel is sufficient to give a ride resilient enough to prevent damage to lading and, also, is about the maximum amount practical for freight cars with the present coupler-height limitations.

Spring-Control Means. Some form of spring control is absolutely necessary and should be adequate to prevent resonance in the system at operating speeds. Mechanical friction offers a satisfactory means to minimize the large-amplitude vibrations developed at critical speeds.

Minimum Control Desirable. Friction spring control, by its very nature, increases the spring resistance; it makes spring action more sluggish and less effective as a cushioning means. Hence there is a certain optimum amount of control or friction which cannot be exceeded without detracting from the smooth riding qualities so essential in high-speed service.

Adequate Reserve Travel Under Maximum Static Load. Sufficient additional or reserve travel should be present in the suspension system after the full static load has been applied to handle the dynamic shocks that will be encountered from track irregularities. If this is not available, there is the danger of springs going solid with resulting loss of cushioning.

Spring Planks. The question of the necessity for a spring plank in a freight-car truck is one that has and still receives a great deal of discussion. Well over 100,000 freight cars designed for the elimination of the spring plank, have been in service on the railroads of this country for many years. Periodic inspections have shown them to be operating satisfactorily and safely. The elimination of the spring plank not only omits a troublesome part but permits a reduction in weight and allows additional room for longer-travel springs.

It has been thoroughly demonstrated that resilient squaring means may be used which will prevent undesirable truck actions, such as nosing, shimmy, and racking. The use of such devices will permit the truck to go out-of-square naturally, in negotiating a curve, but will tend to bring it back into square again after this need has passed.

Swing Motion Not Necessary. It has been proved, at least to the author's satisfaction, by riding test cars equipped with nonswing-motion trucks at speeds up to 96 mph, that this method of absorbing the lateral forces is not necessary. Other means, such as resilient or frictional control, are suitable and entirely safe and result in considerable saving in weight and cost.

Low Weight and Cost Important. Economy in the use of materials is generally recognized. Simplicity, few parts, ease of manufacture, minimum weight yet adequate strength, and low maintenance are some of the things that should not be overlooked in high-speed-truck designing.

Considerable progress has been made in the last few years in the use of alloy steels for freight-car parts. The tank program for the U. S. Army has been very helpful to the participating foundries in the casting and heat treatment of alloy-steel castings. The experience gained in the production of armor castings is available for the manufacture of lightweight, high-tensile-steel bolsters, side frames, and other truck parts.

Lightweight freight-car trucks and cars become increasingly important as the weight restrictions previously mentioned are put into effect. For instance, a 50-ton car suitable for a maximum load at rail of 169,000 lb may weigh 50,000 lb empty. If the load is restricted to 145,000 lb or less, then the lightweight of the car should likewise be reduced.

Separable Journal Boxes. The author believes that it has been thoroughly demonstrated that a freight-car truck can be designed to operate safely and give an excellent, smooth, soft ride at high speeds with a controlled spring system under the bolster. Such a design uses side frames, with journal boxes cast integral, generally lighter and more economical than the separable types with spring systems at the boxes.

Roller Bearings. The roller-bearing freight-car truck is still in the future. A few test installations have been made and results have been carefully watched. The subject is again receiving a good deal of attention and study. Generally speaking, roller bearings may be added to central-spring-system types of trucks by providing the side frame with pedestal jaws to take the roller-bearing journal boxes. Standardized dimensions for such pedestal openings are desirable to eliminate pattern alterations when different roller bearings are used.

Trucks with spring systems over the boxes may also use roller bearings, depending on the spring and control arrangement and design of roller bearing.

Side Bearing. Proper side-bearing clearances are extremely important to insure satisfactory truck performance. Many derailments that could have been avoided by more frequent inspections and adjustments have been caused by insufficient side-bearing clearance. The truck designer has not had a great deal to say about this very important matter. He is requested to supply places on the bolster for the application of side bearings at designated locations. It then becomes the responsibility of the carbuilder and railroad to see that proper clearances are provided and maintained.

Center Plates. Nothing has been found in extensive road testing and inspections to indicate that the present A.A.R. design of flat center plate is not entirely satisfactory. Adequate bearing area is necessary for low unit pressures to insure satisfactory life and ease of swiveling. It is felt that the 12-in-diam center plate for 40- and 50-ton cars, and 14-in. for the 70-ton equipment accomplish this purpose.

Elliptical Springs. A great deal of study and experimental work have been devoted to the subject of elliptical springs and their use in freight equipment. It is possible to use an elliptical spring in conjunction with the present A.A.R. 1915 and 1936 helical coils, having $1^5/_8$-in. travel, but there are several disadvantages, as follows:

1 Weight: The elliptical spring is fundamentally heavier than the coil spring for the same resilience, or capacity to absorb work.

2 Cost: It is more expensive because it is an assembly of parts, as well as being heavier.

3 Flexibility: The necessary capacity, together with the short length permissible, force the design to be relatively stiff, so that it cannot readily be used with the long-travel spring groups that we now know are essential to smooth riding.

Brakes. The brake equipment and foundation rigging commonly used on all freight cars have in general performed satisfactorily in freight-train service and at present freight-train speeds. It is quite apparent, however, that the trend is definitely toward higher speeds, lightweight cars with the resulting high weight ratio, and a broader use of freight-type cars in head-end passenger-train service. These probabilities point rather definitely to the need for more adequate braking apparatus to control properly freight-type cars at the higher speeds. In the case of head-end passenger-train operation the brake system must be more in harmony with that now employed on passenger cars and thus consideration should be given to the use of clasp brakes, truck-mounted brake cylinders, bushed levers and rods and the various quick-action and release features now more or less common to passenger equipment. Likewise, the wide differential in weight at the rail between empty and loaded cars requires some compensating means such as an empty-and-load or a variable-load brake system to provide braking uniformity and equalization throughout the train.

From a mechanical and design standpoint the present freight-car brake with respect to the trucks is rather simple, requiring nothing more than suspension means on truck sides, dead-lever brackets on bolsters, and such other brackets or shelves as are used for brake-beam safety guards. However, should the operating conditions set up by higher speeds lead to the employment of truck-mounted brake cylinders, clasp brakes, and foundation brake gear approaching the present passenger types, the truck design is materially affected. Not only are design problems involved pertaining to clearances, weight, and strength of the component parts, but possibly riding qualities would be influenced. For these reasons the author strongly feels that the truck manufacturers should have more of a voice in all matters relating to truck design, the spring systems employed, and the brake arrangement.

CONCLUSION

Considerable data have been accumulated by the A.A.R., also by freight-car-truck manufacturers, relative to riding qualities and performance of trucks at high speeds, which has resulted in the improvement in freight-car suspension systems and truck design so some are capable of operating safely and satisfactorily at speeds of 90 mph or over.

In the author's opinion, there is still need for additional tests and investigations to determine, for instance, the impacts that are transmitted directly through the wheels to the journal boxes of the side frame and the corresponding impact received by the car body; the effect of long lengths of continuous rail on riding qualities of freight trucks; effect of relatively solid and unyielding roadbed which may be introduced into the track structure in the future by the increasing use of concrete.

These questions should be anticipated and it is hoped that before long the transportation situation will permit more extensive road testing than has been possible in the last few years, so that the answers to these, as well as other questions, may be obtained.

Paths to SMOKE ABATEMENT

By RALPH A. SHERMAN

SUPERVISOR, FUELS DIVISION, BATTELLE MEMORIAL INSTITUTE. MEMBER A.S.M.E.

THAT pollution of the atmosphere by dust, smoke, or noxious gases has a bearing on the physical, economic, and social welfare of a community is indisputable. Everyone feels invigorated on a day with clear blue skies, bright sunshine, and fresh, bracing air. Everyone feels depressed on dark days when the sun and even near-by objects are obscured by a pall of fog or smoke, and when he is forced to breathe air that is odorous or noxious.

Dust, fumes, and smoke injure buildings, metal, furnishings, and clothes. They may lead to impaired health. Men go to the country, the mountains, or to the seashore on their vacations. Men move to the suburbs to live in a cleaner atmosphere. Whole sections of cities change in character as one class of people moves from a district because of smoke, and another class moves in. Yet no matter where he goes man is exposed to dust. As Blacktin says in his book, "Dust," "Humanity has no escape from the constant, continuous, visible and invisible, variable smoke atmosphere from birth to death. For the earth contains no known quite dust-free place."

WHY ARE CITIES SMOKY?

We are part of an industrial civilization. For the most part, we are proud of this civilization and its accomplishments. But an industrial civilization has meant the concentration of industry in economic locations, and the concentration of the people to man the industry in cities and metropolitan centers. Wherever the density of industry and of population increases, the dust problem will increase. The very elements that make for great centers of industry and population contribute largely to the problem of air pollution.

Unfortunately also, the geographical factors that fix the location of a city often contribute to the smoke problem. Before the days of railroads or canals, rivers were the principal arteries of transportation and remain important today. Large rivers often mean fogs and usually are associated with hills and valleys. In the valleys there are often low wind velocities which means that fog and smoke may hang stagnant for long periods.

Most of the cities that have become great industrial and manufacturing centers have become so because they were located near sources of bituminous coal, which is the basic source of energy for industry.

One could discuss at length these factors of geography and accessibility to coal that have determined the location and growth of our cities, but the naming of a few examples, such as Pittsburgh, St. Louis, Cincinnati, Indianapolis, and Columbus, will suffice.

If we were content to eliminate our industry, if we were content to return to an agricultural economy, if we wanted to return our cities to pleasant country towns, we could largely eliminate our smoke problem. But few have such a vision for these United States.

If we are to retain our industrial civilization, we must accept the fact that we cannot eliminate smoke. But there is no reason why we should not abate it, and thus make our cities much more livable than if we did nothing about the problem.

Several methods of approach are possible. A method that is suitable for Chicago will probably not do for Washington, D. C. One that is good for Cincinnati may not be good for Los Angeles. A method that is proper for St. Louis is not necessarily good for Indianapolis. Any method is likely to be a compromise. We must do all that we can to abate smoke without serious harm to the industry and the people who are dependent upon that industry.

Presented at a meeting of the Central Indiana Section, Indianapolis, Ind., January 12, 1945, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

LEGISLATION ON SMOKE ESSENTIAL

The first step on the path to smoke abatement is the adoption of an ordinance intelligently written for the particular needs of the community. To assist cities in the preparation of such ordinances, the Fuels Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS set up a few years ago a committee to prepare a model smoke law. This committee has worked hard, and the draft of the law is now practically completed; before very long it should be available.

Any ordinance to be effective must be all-inclusive, excepting no type or source of smoke, dust, or gases from its provisions. It is obvious that thorough policing of every residential chimney is an impossibility. But in the handling of the traffic problem, continual policing of every stop light and stop sign is likewise an impossibility. The provision of penalties for the willful violator who is apprehended is, however, conducive to compliance of traffic, and it will be likewise conducive in compliance with smoke regulation.

Frequently, in cities that have an ordinance on their statute books but where smoke conditions are bad, blame is placed on the inadequate ordinance. This may be true, but the blame can often be placed on inadequate enforcement.

The best of smoke ordinances is no magic wand that will clear the air by itself. An adequately manned smoke department is necessary. Regulation of smoke is first of all an engineering job and requires a well-trained and experienced engineer. It is also a job of public relations because the best results are obtained not by use of the police power, however necessary this may be, but by education and co-operation. A man capable of combining these engineering functions and public relations can command in other fields a high salary, and a city must be prepared to pay a similar salary if the properly qualified engineer is to be obtained.

Smoke abatement is not a one-man job, and the chief smoke-abatement engineer must have an adequate force of qualified assistants to handle the city. They should be either practical engineers or be trained as such by the chief smoke-regulation engineer that they may be able not only to detect violations, but to go into the plant to show how the smoke can be stopped. They, also, must be paid salaries commensurate with the ability demanded.

TWO GENERAL METHODS FOR SMOKE ABATEMENT

Freedom from smoky chimneys can be obtained in two ways, either by the use of fuels that cannot smoke, or by the use of equipment that will burn the potentially smoky fuels without smoke.

Anthracite and Coke. The only two truly smokeless fuels are anthracite and coke. As is well known, anthracite is produced only in the eastern part of Pennsylvania and to a small extent in Arkansas. However desirable anthracite may be from the standpoint of its ability to burn smokelessly, it is obvious that the producing fields lie too far from large parts of the country for this fuel to be the general answer to the smoke problem.

Coke, which is made by heating bituminous coal in ovens to

drive off the volatile matter or smoke-making constituents which are collected as tar and gas, is an excellent fuel for residential heating and certain industrial applications. Coke had had an increasing acceptance for residential use before the war, but this use had to be reduced during the war because of the expanded need for coke for the blast furnace and for foundry cupolas.

After the war even greater amounts of coke than previously will be available for residential use, because of the increase in the number of by-product coke ovens during the war and an expected decrease in production of iron and steel. It is not likely, however, that all the needs of many cities could be met with coke, as in making the coke gas is also made and the production and consumption of coke and of gas must be kept in balance.

Some years ago great hope was held out for the solution of the smoke problem in the production of low-temperature coke. The greater production of tar, tar acids, and light oils would, it was hoped, prove so valuable as chemical raw materials, that the coke could sell at a relatively low price. The low-temperature coke has, in general, an advantage for residential equipment over high-temperature coke produced in by-product ovens in that it is more reactive; that is, it ignites more readily and thus gives less trouble from fires going out than often is encountered with high-temperature coke.

The failure of many of the low-temperature coking processes tried some years ago, either to work satisfactorily or to operate profitably, has cast a general doubt on the feasibility of low-temperature processes. This is unfortunate as an open mind should be retained. One can hope that a process, sound both technologically and economically, will be developed. It would undoubtedly aid materially in the solution of the smoke problem for many cities.

Smokeless Coals. We are fortunate to have in the United States considerable reserves of low- and medium-volatile coals, often called "smokeless" coals. These coals are in general of high quality and, although not entirely smokeless, will burn in ordinary hand-fired equipment with such a low production of smoke that they will usually meet smoke-abatement ordinances.

The two principal low-volatile coal fields are those of central Pennsylvania and southern West Virginia. A glance at the map of the coal fields shows that these fields are small in comparison with those where high-volatile coal is produced. Although the reserves are said to be enough for over 300 years, the fact that the production of low-volatile coal is now 20 per cent of the total production, whereas the reserves are but 2 per cent of the total coal reserves, makes it obvious that we are using this coal at a high relative rate.

Not only is low-volatile coal used for residential heating, but it is also considered by many producers of metallurgical coke to be essential for blending with high-volatile coal. This demand is high and the reserves of the best coals for this purpose are now dwindling.

Because of the relative scarcity of low-volatile coal, and its distance from many of the cities of the country, it is obvious that all cities cannot depend upon the use of this coal for the solution of their smoke problems. There is unfortunately, not enough of this good coal to go around.

Oil and Gas. Oil is a smokeless fuel when used in properly designed, properly installed, and properly adjusted equipment. In many parts of the country it is more expensive than coal. In the future, as our reserves decrease and we are forced to import oil or to produce it from coal, the cost is likely to go even higher.

As a matter of national policy, large increases in the use of oil for residential heating are not to be recommended. Faced with a shortage of oil, it is essential that the available supply be conserved for the Navy, for gasoline, and for other uses that oil can fill most economically.

Natural gas has been made available to many cities far from the present principal producing fields, Texas and Louisiana, by means of long-distance pipe lines. It is a thoroughly acceptable smokeless fuel, but its cost puts it beyond the reach of many people for residential heating.

The use of manufactured gas for residential heating has greatly increased in recent years and will undoubtedly increase further if research now under way by both the coal and manufactured-gas industries is successful in obtaining its objective of lower-cost processes for production of gas from coal.

Smokeless Equipment for Bituminous Coal. The majority of residential boilers, warm-air furnaces, and stoves are still fired by hand. Completely smokeless operation of such equipment is admittedly very difficult. It can be done by careful firing, but this usually means more trips up and down stairs to the basement and few men or women who usually fire the furnace will make the effort to attain smokeless operation. There is no question, however, that considerable improvement is possible if residential equipment is included in the ordinance and is enforced.

One of the most difficult of the problems is that of the stove or space heater. Many probably think that the parlor stove has passed completely out of the picture and will be surprised to know that the 1940 census figures show that there are now some 7,000,000 coal-burning stoves in use in the United States. These stoves have changed somewhat in outward appearance, but have not been fundamentally changed in principle since the stove was invented by Franklin. Recognizing the responsibility of the bituminous-coal industry to make available the equipment that will burn bituminous coal without objectionable emission of smoke, Bituminous Coal Research, Inc., the research agency of the industry, several years ago initiated a program at Battelle on the development of a smokeless stove. In this they were joined by a group of 27 of the leading stove manufacturers of the country.

The stated objective of the project was a simple nonmechanical device that would burn without objectionable smoke, would be reasonably efficient, would preferably be of the magazine type that would burn for long periods without attention, and would be reasonably low in cost. They have now developed a stove that appears to meet the objective laid down. Some six of the stove manufacturers in the program have been able to build trial models, and one manufacturer put out about 20 for field trials in the winter of 1944, and approximately 50 of an improved model for field trials during the 1945 season. The stove is attractive in appearance, and from all reports on stoves placed in various cities from Wyoming to West Virginia, was practically completely smokeless in operation. Some mechanical faults were uncovered and it is expected that others will be seen in those models put out this year.

The same principle is to be built into a kitchen range, into water heaters, and into warm-air furnaces. In addition to this development, the University of Illinois has developed a smokeless furnace, known as the Fellows or Illinois furnace, which has been tested thoroughly at the research residence of the National Warm-Air Heating and Air Conditioning Association at Urbana. At least two manufacturers are putting out experimental models this year, and it is expected that others will follow.

A method of firing bituminous coal in furnaces or boilers for residential heating that will give satisfactorily smokeless operation is that of the underfeed stoker. The growth of this industry during the years before the war was remarkable, and more than 1,000,000 stokers are reported to be in use in the country at the present time.

Some outstanding new developments are promised in residential stokers for the postwar period. With one exception

at the present time, the stokers now sold for residential heating are of the type in which the ash is removed manually as clinker. The exception removes the ash automatically and places it in a container for easy removal from the basement. One of the problems of these small stokers is the difficulty of using strongly coking coals, some of which are the best coals from the standpoint of quality and heating value. Battelle has developed a stoker which by mechanical means breaks up the coke formation and permits the use of these strongly coking coals. At The Pennsylvania State College, a research project jointly supported by the Commonwealth of Pennsylvania and the bituminous-coal producers developed a principle of admission of air into the fuel bed, called the preoxidation principle, that also eliminates the difficulty from coke formations. Both of these stokers are now in the hands of manufacturers for development and are to be built with automatic ash removal.

Architects and builders tell us that after the war the homes that are to be built are to be small, well insulated, and weather-stripped, and are to require only a maximum of 40,000 to 50,000 Btu per hr in severest weather. These homes are to be of low cost, and the owner should have the possibility of using a low-cost fuel. He also would like to have automatic heat. The manufacturers of coal stokers state that the problem of building a stoker that will feed the 5 to 10 lb of coal per hr to be required at a cost comparable to that at which oil and gas burners for similar output can be sold is extremely difficult. For Bituminous Coal Research, Inc., Battelle is looking into the possibilities of giving these people not only the advantages of low-cost heat from bituminous coal but the most completely automatic and trouble free heat that can be furnished, i.e., from central heating by a small plant that will heat a block of these houses which may be built in one locality. The possibility of the elimination of chimneys, of fuel-storage space, of the entire furnace or boiler, and the lack of any attention whatsoever are certain to be very appealing to the homeowner. The use of coal in a central heating plant of larger size in equipment now proved to be smokeless in operation will make it possible to have these developments smoke-free.

INDUSTRIAL UTILIZATION

Equipment has long been available by which coal can be fired at rates of 100 lb to several tons per hr under boilers for steam or power generation with smokeless operation. This equipment includes the underfeed stoker, pulverized coal, and the more recently developed spreader stoker. Although this equipment can burn coal smokelessly, improper installation, improper operation, or improper maintenance can lead to bad smoke emission even with this good equipment. Surveys that have been made have shown that one of the principal causes of smoke emission from plants is the lack of careful operation and maintenance. Hence, eternal vigilance on the part of the smoke inspector and frequent inspections are required that the smoke emission from these installations be kept down.

In many small commercial and industrial plants hand-fired boilers are still in use. As the fireman often has other duties to perform about the building, the fire does not get the attention that it should, and bad smoke emission often results. The smoke department can well demand either careful and continuous attention to these furnaces or make mandatory the installation of mechanical equipment. Such action is justifiable because the increase in efficiency of the use of the coal by this mechanical equipment will usually save the owner money.

Frequently, in boilers fired by underfeed stokers or spreader stokers, a proper installation has not been made either because of lack of good engineering design or lack of proper space, and even with good attention, smoke emission results from lack of proper mixture of air with the volatile matter above the fire. In such installations, the use of overfire air jets supplied either by fan or by steam jets may be the answer. Overfire air jets are by no means new, as they have been used for many years. The data for their correct design have, however, previously been lacking, and they have had to be built by rule of thumb or by guess. As a consequence, many of them have not worked properly and have been abandoned. Another cause of failure of the fireman to use them is the fact that the overfire steam-air jets are extremely noisy because of the high velocity of the steam jet and the inrushing air.

Bituminous Coal Research, Inc., has at Battelle recently conducted a thorough investigation of the fundamentals of the design of overfire air jets and has provided in three publications, the last of which is a brief practical treatise for the fireman or engineer, data with which these jets can be properly designed and installed. Included are recommended methods for the installation of simple silencers that will reduce the noise by as much as 90 per cent.

One fertile field for the installation of overfire air jets is on steam locomotives. As in stationary practice, these have long been tried but were not often used both because of lack of proper design and because of the noise. The information published on the use of these jets has attracted wide attention among the railroads, and at least seven have installed jets on one or more locomotives. Through the activities of E. D. Benton, fuel engineer of the L. and N. Railroad, and a member of the Technical Advisory Board of Bituminous Coal Research, Inc., to whom credit is due for suggesting the investigation of overfire air jets, his railroad has installed jets on more than 100 locomotives and is rapidly installing them on others. One railroad has recently ordered ten new locomotives which will come from the builder equipped with overfire air jets.

The operation of steam locomotives without the emission of smoke is not a simple problem, but the application of these jets will make the problem much easier. Furthermore, experience has shown that any city can depend on the co-operation of the railroads in educating their firemen and reducing the smoke the greatest possible degree.

SUMMARY

The path to a sound program of smoke abatement in any city includes three steps: (1) The adoption of an ordinance that recognizes the industrial requirements of the community; (2) the provision of adequate manpower, adequately paid, to enforce the ordinance; (3) the use of all available means, including the installation of proper equipment and the proper operation of that equipment to operate smokelessly.

The path to smoke abatement is not easy, but it is becoming easier. Through the efforts of the equipment manufacturers and the coal industry, better equipment is now being made available. Whereas some years ago any program of smoke abatement was looked upon with disfavor by the coal industry, now the coal producers and the retail dealers are usually found supporting such a program because they recognize their responsibility. Evidence of this is the program of Bituminous Coal Research, Inc., which is now underwritten by the industry to the extent of approximately $500,000 per year for the next five years. A very large amount of this money is being devoted to research on methods for the utilization of bituminous coal without smoke.

The initiation or expansion of a program on smoke abatement is not most readily done in time of war. Engineers are now busy on many other vital needs, and it is difficult to find the manpower required for the smoke department. However, smoke abatement is badly needed in time of war. Smoky chimneys do not always mean a high waste of fuel, but a high waste of fuel is usually accompanied by smoke, and any smoky chimney may be suspected as being a potential waster of fuel. In such a time of need for economy in the use of all our resources and particularly of coal of which we are now truly desperately short, a waste of fuel should not be tolerated, for such waste may prolong the war.

An Analytical Method of CAM DESIGN

By W. B. CARVER[1] and B. E. QUINN[2]

INTRODUCTION

THE graphical method for determining the contour of a disk cam with a radial-motion flat-faced follower is well known.[3] A curve of follower displacement versus cam rotation must first be drawn, Fig. 2. Using the principle of inversion, the follower is then drawn in selected angular positions about the center of the cam. A curve, tangent to the follower in the revolved positions, is the cam contour. This contour is actually the envelope of the straight lines which represent the working face of the follower in various positions around the cam. In this procedure the points of contact between the cam and the follower are initially unknown, and it is difficult to estimate their exact location.

A further difficulty is sometimes encountered. If the assumed minimum radius of the cam is not large enough, the cam may require cusps to give the desired motion. A cam contour with cusps is shown dotted in Fig. 5, and it can be seen that such a contour is impractical. These cusps can be avoided by increasing the radius of the cam. The minimum radius to avoid cusps is difficult to determine graphically except by trial, but can easily be found analytically. Parametric equations of the cam contour give the outline of the cam to any desired degree of accuracy in the analytical method, and the location of the point of contact can quickly be found.

EQUATIONS OF CAM CONTOUR AND MINIMUM RADIUS OF CAM

In Fig. 1, is shown a disk cam with a flat-faced radial follower. The cam rotates about the center O with a constant angular velocity. The displacement of the follower from the origin is indicated by R and

$$R = C + f(\theta) \quad [1]$$

where the minimum radius of the cam is represented by C, and $f(\theta)$ represents the desired motion of the follower as a function of the angular displacement of the cam.

It is not necessary that one expression should represent the entire motion of the follower for a complete revolution of the cam. In Example 3, different expressions represent the motion of the follower during different parts of its travel. It is necessary, however, that the curve of follower displacement versus cam rotation, Fig. 2 have no discontinuity in the slope, and that the slope have a finite value for all values of θ. It is also required that the right- and left-hand second derivatives of the curve exist for all values of θ, but for a finite number of points they need not be equal. It will be convenient in drawing the curve of follower displacement versus cam rotation to have the minimum value of follower displacement at $\theta = 0$.

Assume axes X and Y are attached to the cam as shown in Fig. 1, with the origin at the center of rotation and the positive end of the X-axis along the minimum radius. The value of θ will be measured from the positive X-axis to the center line of the follower. Then the face of the follower will be represented by the equation of a straight line

$$y = mx + b \quad [2]$$

where

$$m = \tan(90 + \theta) = -\cot\theta \quad [3]$$

$$b = R\csc\theta \quad [4]$$

In Equation [4] the value of R can be replaced by Equation [1], then Equations [3] and [4] can be substituted in Equation [2] to give

$$C + f(\theta) = x\cos\theta + y\sin\theta \quad [5]$$

The contour of the cam will be the envelope of these lines as θ varies.[4]

Differentiating Equation [5] with respect to θ gives

$$f'(\theta) = y\cos\theta - x\sin\theta \quad [6]$$

solving Equations [5] and [6] for x and y

$$\left.\begin{aligned} x &= [C + f(\theta)]\cos\theta - f'(\theta)\sin\theta \\ y &= [C + f(\theta)]\sin\theta + f'(\theta)\cos\theta \end{aligned}\right\} \quad [7]$$

These are the parametric equations of the cam contour.

The curve given by Equations [7] will be a closed curve. If the curve has cusps, it will be unsatisfactory for use as a cam contour. That cusps can be avoided by keeping C above a certain minimum value may be shown as follows:

Cusps can occur only when

$$\frac{dx}{d\theta} = \frac{dy}{d\theta} = 0 \quad [8]$$

It is thus necessary to differentiate Equations [7] and to determine the value of C necessary to prevent the condition indicated by Equation [8].

Thus

$$\left.\begin{aligned} \frac{dx}{d\theta} &= -[C + f(\theta) + f''(\theta)]\sin\theta \\ \frac{dy}{d\theta} &= [C + f(\theta) + f''(\theta)]\cos\theta \end{aligned}\right\} \quad [9]$$

Since $f(\theta)$ and $f''(\theta)$ are bounded, it is possible to select a value of C such that

$$C + f(\theta) + f''(\theta) \quad 0 \quad [10]$$

for all values of θ. If C fulfills this condition, $\frac{dx}{d\theta}$ and $\frac{dy}{d\theta}$ cannot both be zero simultaneously, and the cam contour given by Equation [7] will be free of cusps.

LOCATING POINT OF CONTACT BETWEEN CAM AND FOLLOWER

To determine the required length of face of the follower, it is necessary to determine the locus of the points of contact between the cam and the follower. In Fig. 1, the point of contact is indicated by (x, y) and the center of the follower by (x_0, y_0). The distance from the center of the follower to the point of con-

[1] Professor of Mathematics, Cornell University, Ithaca, N. Y.

[2] Instructor in Machine Design, Sibley School of Mechanical Engineering, Cornell University, Ithaca, N. Y. Mem. A.S.M.E.

[3] "Kinematics of Machinery," by C. D. Albert and F. S. Rogers, John Wiley & Sons, Inc., New York, N. Y., 1931, p. 169.

[4] "Elements of the Differential and Integral Calculus," by W. A. Granville and others, Ginn & Company, New York, N. Y., revised edition, 1941, p. 467.

tact is given by S. If this distance is measured in the direction of θ increasing it is considered positive, and in the opposite direction it is considered negative. It has already been shown in Equation [7] that

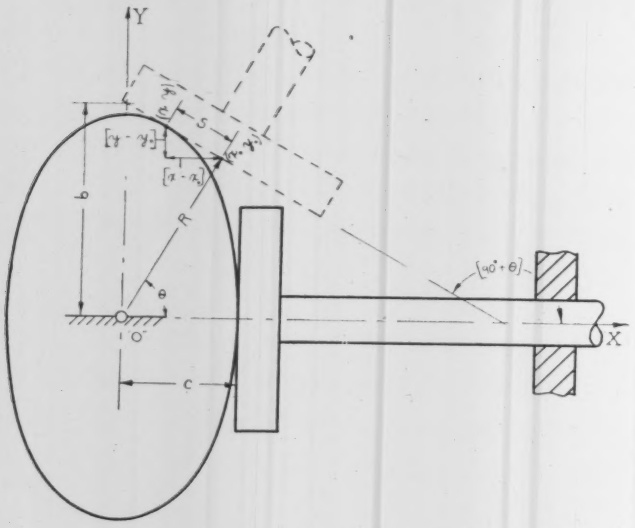


FIG. 1 DISK CAM WITH A RADIAL FLAT-FACED FOLLOWER

$$\left.\begin{aligned} x &= [C + f(\theta)] \cos\theta - f'(\theta) \sin\theta \\ y &= [C + f(\theta)] \sin\theta + f'(\theta) \cos\theta \end{aligned}\right\} \quad \ldots\ldots [11]$$

From Fig. 1

$$\left.\begin{aligned} x_0 &= [C + f(\theta)] \cos\theta \\ y_0 &= [C + f(\theta)] \sin\theta \end{aligned}\right\} \quad \ldots\ldots [12]$$

then

$$S^2 = (x - x_0)^2 + (y - y_0)^2 \quad \ldots\ldots [13]$$

Substituting Equations [11] and [12] in Equation [13]

$$S^2 = \{([C + f(\theta)] \cos\theta - f'(\theta) \sin\theta) - [C + f(\theta)] \cos\theta\}^2 + \{([C + f(\theta)] \sin\theta + f'(\theta) \cos\theta) - [C + f(\theta)] \sin\theta\}^2$$

which when simplified gives

$$S = \pm f'(\theta)$$

While the foregoing work leaves the sign ambiguous, it can be proved that the positive sign before $f'(\theta)$ is always the correct one, that is

$$S = f'(\theta) \quad \ldots\ldots [14]$$

It is seen that the location of the point of contact between the cam and the follower depends only upon the magnitude of $f'(\theta)$ and is independent of the minimum radius of the cam. The minimum length of the follower face is not affected by changing the minimum radius of the cam. It can thus be seen that the same follower could be used with cams of different minimum radii as long as these cams had the same curve of follower displacement versus cam rotation. The point of contact is at its greatest distance from the center line of the follower when the velocity of the follower is a maximum. This fact can also be determined by other methods.

In Fig. 1 when the follower moves away from the cam with positive velocity, contact occurs above the axis of the follower. In this case S is positive. When the follower moves toward the cam, the velocity is negative, and the resulting negative value of S indicates that contact is below the axis of the follower.

ILLUSTRATIVE EXAMPLES

Example 1. It is required that the follower move out and back with simple harmonic motion for one revolution of the cam. The curve of follower displacement versus cam rotation is shown in Fig. 2. For this type of motion

$$f(\theta) = A - A \cos\theta \quad \ldots\ldots [15]$$

$$f'(\theta) = A \sin\theta \quad \ldots\ldots [16]$$

$$f''(\theta) = A \cos\theta \quad \ldots\ldots [17]$$

The displacement of the follower can be expressed in terms of the minimum radius and the angular displacement of the cam by substituting Equation [15] in Equation [1]

$$R = C + A - A \cos\theta \quad \ldots\ldots [18]$$

The minimum value of C can be obtained by substituting Equations [15] and [17] in Equation [10], in which case

$$C + A > 0 \quad \ldots\ldots [19]$$

Since A must always be a positive number, C could be zero and condition [19] would still be satisfied. This means that no cusps or sharp points would occur on the cam contour if the minimum radius were made equal to zero. Mechanical considerations will, therefore, determine the minimum radius of the cam. This condition exists for many types of motion.

If Equations [15] and [16] are substituted in Equations [7], parametric equations of the cam contour are obtained. Making this substitution

$$\left.\begin{aligned} x &= (C + A) \cos\theta - A \\ y &= (C + A) \sin\theta \end{aligned}\right\} \quad \ldots\ldots [20]$$

In this case the parameter θ can easily be eliminated to give

$$(x + A)^2 + y^2 = (C + A)^2 \quad \ldots\ldots [21]$$

which is the equation of a circle with radius $(C + A)$ and

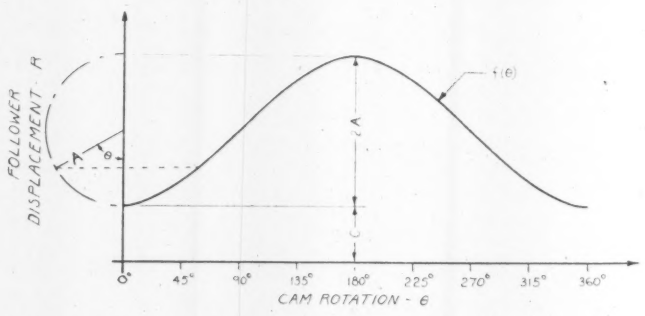


FIG. 2 CURVE OF FOLLOWER DISPLACEMENT VERSUS CAM ROTATION FOR EXAMPLE 1

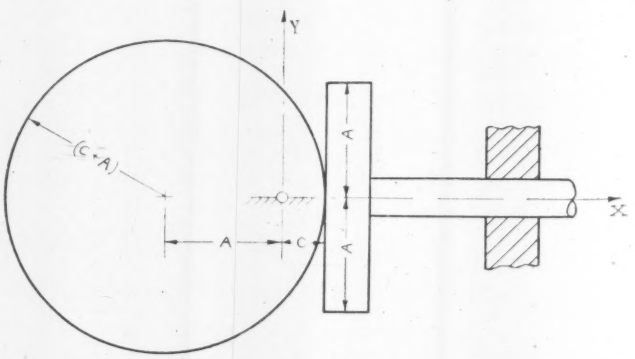


FIG. 3 CAM AND FOLLOWER FOR EXAMPLE 1

center at $(-A, 0)$. In Fig. 3 the resulting cam is shown. The distance between the center of the circle and the center of rotation determines the follower displacement. The center line of the follower does not have to pass through the center of rotation of the cam. The follower is frequently offset to distribute the wear.

The maximum distance of the point of contact from the axis of the follower can be found from Equation [14]. In this case it is the maximum value of Equation [16] which occurs when $\theta = 90$ deg. At this value of θ, the velocity is greatest, and the maximum distance is A. The length of follower face equal to $2A$ would be the smallest possible length that could be used.

Example 2. It is required that the follower move out and back with simple harmonic motion for half a revolution of the cam. Two motion cycles of the follower thus occur for one complete revolution of the cam. The curve of follower displacement versus cam rotation is shown in Fig. 4. For this type of motion

$$f(\theta) = A - A \cos 2\theta \quad [22]$$

$$f'(\theta) = 2A \sin 2\theta \quad [23]$$

$$f''(\theta) = 4A \cos 2\theta \quad [24]$$

The displacement of the follower can be expressed in terms of the minimum radius and the angular displacement of the cam by substituting Equation [22] in Equation [1]

$$R = C + A - A \cos 2\theta \quad [25]$$

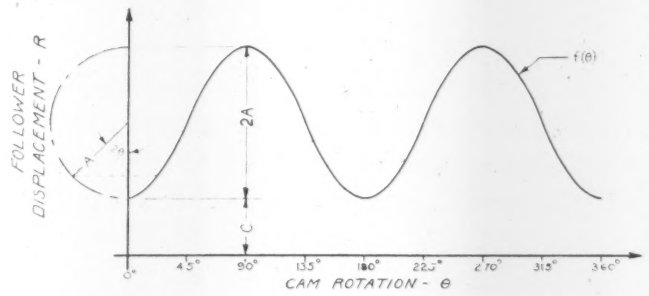


FIG. 4 CURVE OF FOLLOWER DISPLACEMENT VERSUS CAM ROTATION FOR EXAMPLE 2

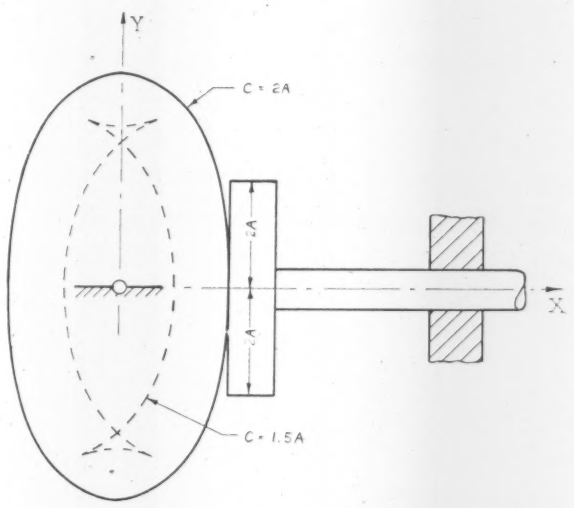


FIG. 5 CAMS AND FOLLOWER FOR EXAMPLE 2

The minimum value of C can be obtained by finding the minimum value of $f(\theta) + f''(\theta)$ and substituting in Equation [10], in which case

$$C - 2A > 0 \quad [26]$$

If $C > 2A$, the cam contour will be free of cusps and sharp edges. In this case it can be shown that a satisfactory contour will result if $C = 2A$. Values of C slightly greater than the minimum value are generally recommended for design purposes. In Fig. 5, the cam contour is shown for two different values of C. There is no discontinuity in the slope of the curve when $C = 2A$, hence, no sharp edges exist.

If Equations [22] and [23] are substituted in Equations [7], parametric equations of the cam contour are obtained

$$\left.\begin{aligned} x &= (C - 2A)\cos\theta + 2A\cos^3\theta \\ y &= (C + 4A)\sin\theta - 2A\sin^3\theta \end{aligned}\right\} \quad [27]$$

The parameter in Equations [27] is difficult to eliminate. The curve for $C = 2A$ in Fig. 5 looks like an ellipse, but is actually not an ellipse but a curve of higher order.

The maximum distance of the point of contact from the axis of the follower can be found by substituting Equation [23] in Equation [14]. The maximum value of $2A$ occurs when $\theta = 45$ deg. When $\theta = 135°$, the value is $-2A$. The length of face equal to $4A$ is thus the minimum length that can be used if the follower is to be tangent to the cam in all positions.

Example 3. Different expressions can be used to represent the motion of the follower during different portions of its travel. The curve of follower displacement versus cam rotation, shown in Fig. 6, is a typical example. The follower be-

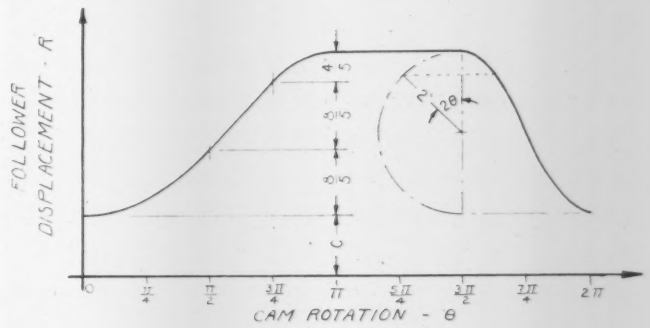


FIG. 6 CURVE OF FOLLOWER DISPLACEMENT VERSUS CAM ROTATION FOR EXAMPLE 3

gins its motion cycle with constant acceleration, then travels with constant velocity. Under a constant deceleration it comes to rest, and then has a dwell. It returns to the initial position with simple harmonic motion.

Each type of motion of the follower must be represented by an expression in θ. Five expressions are thus required in this example. These expressions are given in Table 1 under the interval of cam rotation through which they represent the motion of the follower.

To facilitate computations, the rotation of the cam is expressed in radians, and a distance of 4 in. represents the length of stroke of the follower.

Into Equation [10] must be substituted the minimum value of $f(\theta) + f''(\theta)$ for each type of motion in order to determine the value of C necessary to satisfy the inequality. Only during the return of the follower is C required to be greater than zero. This value of C is equal to 4 in., as shown in Table 1, and is the minimum radius of this cam.

The parametric equations of the cam contour can be ob-

TABLE 1 EXPRESSIONS REPRESENTING MOTION OF CAM FOLLOWER

	Interval of cam rotation θ				
	$0 \leqq \theta \leqq \frac{\pi}{2}$	$\frac{\pi}{2} \leqq \theta \leqq \frac{3\pi}{4}$	$\frac{3\pi}{4} \leqq \theta \leqq \pi$	$\pi \leqq \theta \leqq \frac{3\pi}{2}$	$\frac{3\pi}{2} \leqq \theta \leqq 2\pi$
Type of motion	Constant acceleration	Constant velocity	Constant deceleration	Dwell	Simple harmonic
$f(\theta)$	$\frac{32}{5\pi^2}\theta^2$	$\frac{8}{5} + \frac{32}{5\pi}(\theta - \frac{\pi}{2})$	$4 - \frac{64}{5\pi^2}(\pi - \theta)^2$	4	$2 + 2\cos(2\theta - 3\pi)$
$f'(\theta)$	$\frac{64}{5\pi^2}\theta$	$\frac{32}{5\pi}$	$\frac{128}{5\pi^2}(\pi - \theta)$	0	$-4\sin(2\theta - 3\pi)$
$f''(\theta)$	$\frac{64}{5\pi^2}$	0	$-\frac{128}{5\pi^2}$	0	$-8\cos(2\theta - 3\pi)$
Largest value of $f'(\theta)$	$\frac{32}{5\pi}$ (2.06 approx.)	$\frac{32}{5\pi}$ (2.06 approx.)	$\frac{32}{5\pi}$ (2.06 approx.)	0	-4
Minimum value substituted in $C + f(\theta) + f''(\theta)$	$C + \frac{64}{5\pi^2}$	$C + \frac{8}{5}$	$C + 4 - \frac{16}{5\pi} - \frac{128}{5\pi^2}$	$C + 4$	$C + 2 - 6$
Minimum radius C	$C > -\frac{64}{5\pi^2}$	$C > -\frac{8}{5}$	$C > -0.604$ (approx.)	$C > -4$	$C > 4$

tained by substituting in Equations [7] the expressions for $f(\theta)$ and $f'(\theta)$. These equations will give the contour of that portion of the cam over which $f(\theta)$ represents the motion of the follower. Since there are five different expressions in θ, there will be five sets of parametric equations for the entire cam contour.

COMBINING ANALYTICAL AND GRAPHICAL METHODS

A method for determining the outline of the cam is available which involves less labor than using the parametric equations. It is a combination of both the analytical and graphical methods. For selected values of θ, the corresponding values of R from Equation [1] and S from Equation [14] are computed. For a given value of θ, the exact location of the point of contact is thus known and can be laid out graphically, see Fig. 7. Since this is a point on the cam outline, a curve drawn through several of these points will give the cam contour. In the purely graphical method, the location of the contact point is a matter of judgment and, therefore, the cam contour is less accurately determined. In Fig. 7 is shown the outline of the cam for the previously specified motion.

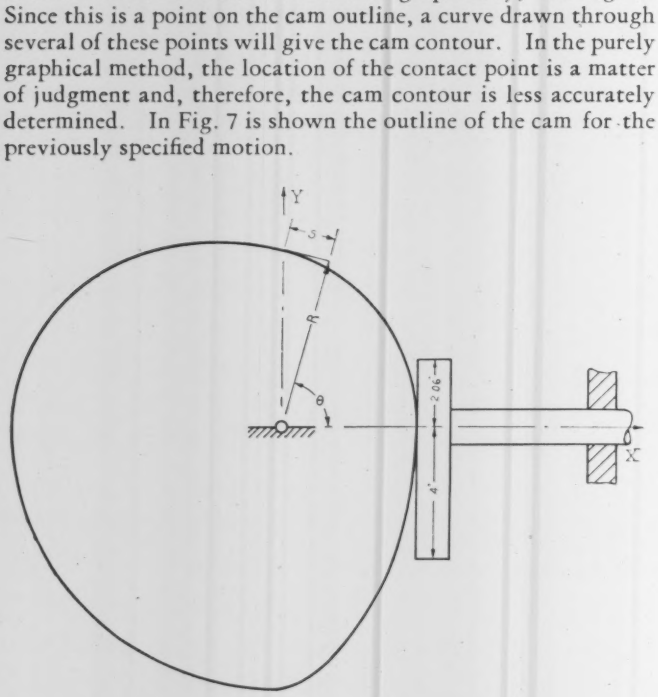


FIG. 7 CAM AND FOLLOWER FOR EXAMPLE 3

The maximum distance of the point of contact above and below the axis of the follower determines the required length of follower face. These distances are determined by substituting the different values of $f'(\theta)$ in Equation [14] and obtaining the largest positive and negative values (see Table 1). In this example, the contact point rises to a maximum distance of 2.06 in. above the follower axis during the outward motion of the follower, and drops 4 in. below the follower axis during the return motion. The minimum length of the follower face is, therefore, 6.06 in.

It can thus be seen that the analytical method can be used to obtain design information when the follower has several types of motion during its cycle.

CONCLUSIONS

The analytical method yields four items of information that are of value in designing a disk cam with a flat-faced radial follower.

1 The minimum radius of the cam can easily be found.

2 The minimum length of follower face can be determined

3 The location of the point of contact can be found.

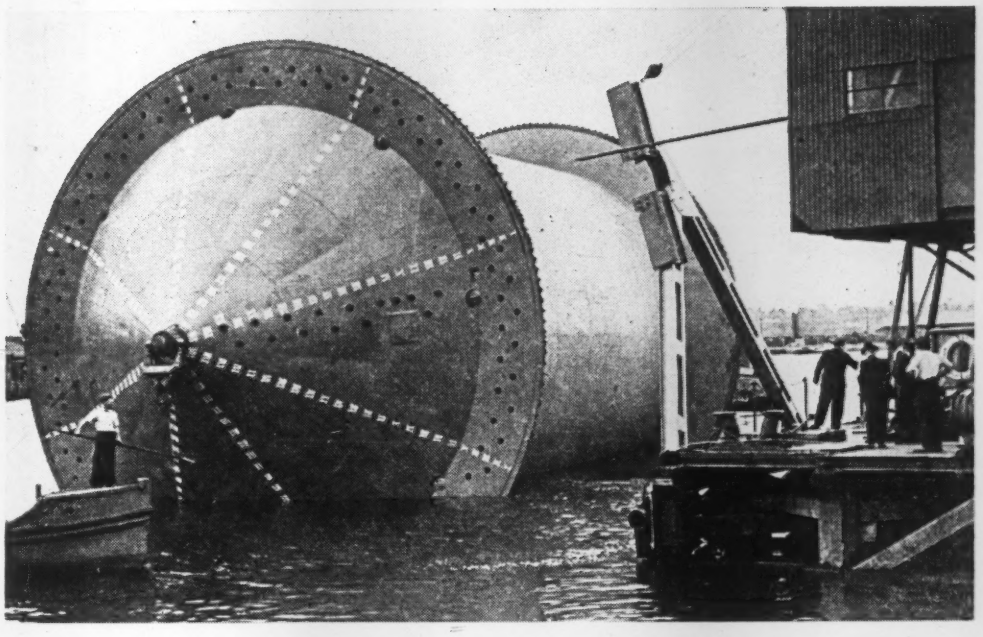
4 Parametric equations of the cam contour can be determined.

Knowing the minimum radius of the cam, the designer can select the smallest cam that will fulfill the requirements. The minimum length of the follower face can also be determined, and it is shown that this length is independent of the size of the cam. It has also been shown that the accuracy of the graphical method can be improved by computing the location of the point of contact. These three items of information are available without the use of the more complicated parametric equations which give the cam contour. These parametric equations can be used to determine the outline of the cam to any desired degree of accuracy. Knowing the outline, it is possible to make more accurate contour approximations for machining purposes.

While the investigation is being continued on the disk cam with other types of followers (radial-motion roller follower, oscillating-motion roller follower, and oscillating-motion flat-faced follower), it seems at present that the analysis of the radial-motion flat-faced follower will yield the greatest amount of design information for a minimum amount of mathematical labor.

ACKNOWLEDGMENT

The authors wish to thank Prof. P. H. Black of Cornell University for his interest and assistance in preparing this paper.



A "CONUNDRUM" BEING MOVED INTO POSITION FOR LOADING THE STEEL PIPE

(These gigantic seagoing "bobbins" were towed by the Royal Navy across the Channel to lay continuous lengths of pipe 70 miles long—when fully loaded they weigh 1600 tons.)

"OPERATION PLUTO"

The Story of the English Channel Pipe Line

FROM August 12, 1944, to May 8, 1945, about 120,000,000 gallons of gasoline reached the Anglo-American Armies in Europe via the pipe-line system laid under the English Channel by British engineers in co-operation with the British Navy. One million gallons daily still reach France by way of 20 undersea pipe lines. Sixteen of these run from Dungeness, on the southeast coast of England, to Boulogne and four from the Isle of Wight to Cherbourg and thence are carried via high-pressure gasoline lines to the Rhine. This vast engineering feat was called "Operation Pluto," meaning "Pipe line Under the Ocean," and guaranteed uninterrupted delivery of bulk petroleum, usually needing a special harbor and dock and extensive storage facilities, across the beaches, making it invulnerable to air, surface, or submarine attack, and completely independent of the weather.

UNITED STATES FIRMS SUPPLY SPECIAL CABLE

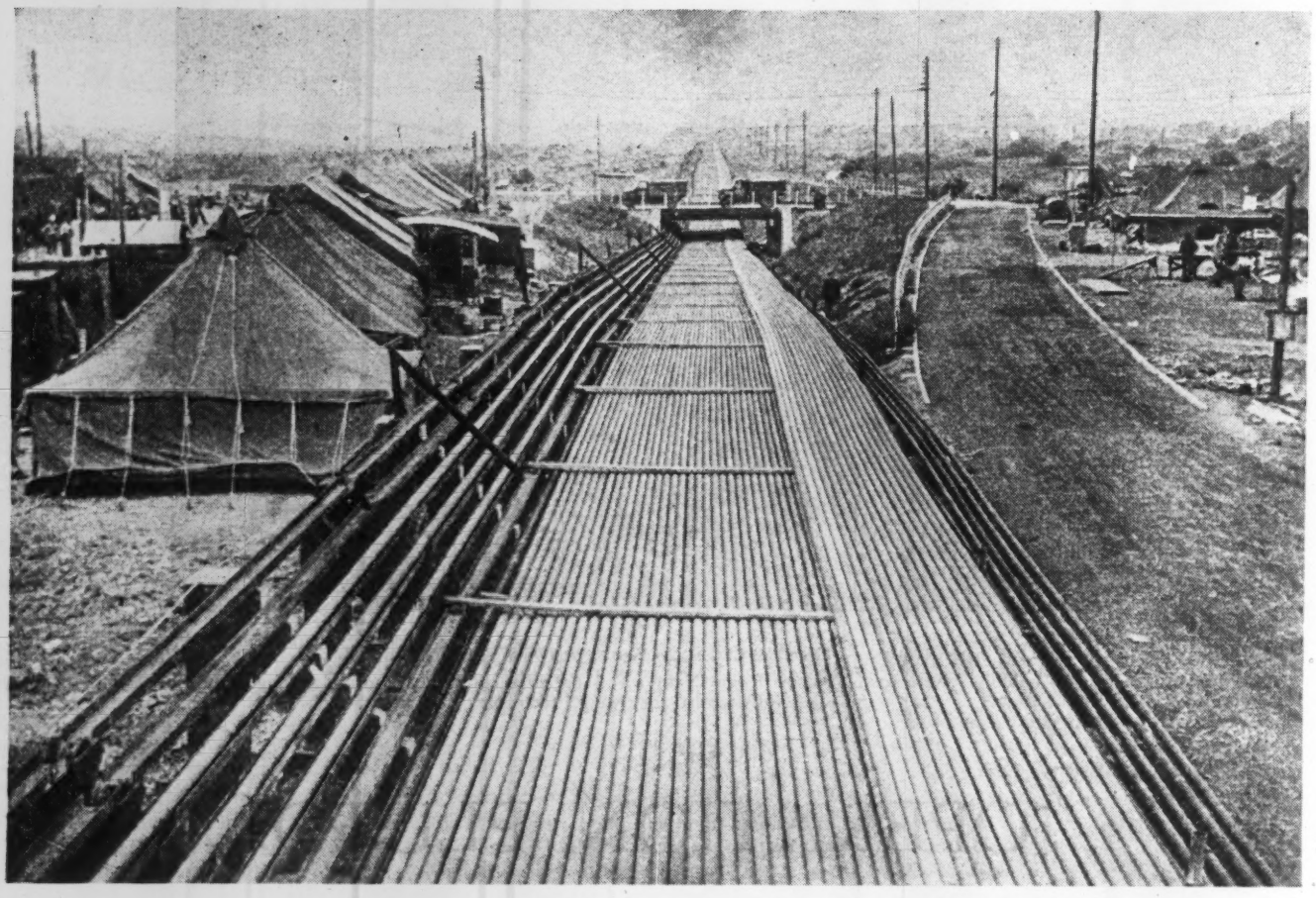
While the British Pluto project was under way, the United States Army was working on a similar idea. After discussions between the respective authorities, it was agreed that efforts should be concentrated on Pluto, and United States authorities magnanimously co-operated fully in many directions. General Eisenhower and his chief officers took an active interest in Pluto's development, and a unit of the United States Army Engineer Corps, under the direction of Col. A. K. Easton, New York, N. Y., arranged for the manufacture of 140 miles of "HAIS" cable by the General Cable Company, Phelps Dodge Copper Products Corp., the General Electric Company, and the Okonite Callender Cable Company. With the exception of the 140 miles of cable manufactured in the United States, the Channel pipe line was a purely British operation in plan and execution.

It was Lord Louis Mountbatten, then head of Combined Operations, who in April, 1942, asked Geoffrey Lloyd, British Minister of Petroleum Warfare, if an oil pipe line could be laid across the English Channel. The experts were doubtful, but A. C. Hartley, chief engineer of the Anglo-Iranian Oil Company, who had used 3-in. high-pressure pipe lines in Persia, suggested a pipe line something like a submarine electric-power cable without cores and insulation, which could be laid across the Channel in a few hours from cable-laying ships.

EXPERIMENTS ASSURE SUCCESS OF OPERATION

By working day and night over two week ends, technicians of the firms of Siemens and Henleys completed the full-scale order for several hundred yards of this pipe line to be laid in the Thames from a cable ship loaned by the British Post Office. The results were so successful that Prime Minister Churchill gave the scheme his blessing, and two 30-mile lengths of cable were ordered to the original 2-in. diam, so that full-scale trials could be held in Bristol Channel, where the currents and other conditions approximated most closely those found in the English Channel. Subsequently, the cable diameters were increased to 3 in. and strengthened for working pressures in excess of 1200 psi. Eight months after Hartley's idea originated, when half a gale was blowing in Bristol Channel, the experimental cable was laid by H.M.S. *Holdfast*, originally a coaster which had been fitted with gear for transporting this unusually heavy cable, and gasoline was delivered from Swansea to Ilfracombe. The fact that the cable was hollow increased the difficulties, since it was liable to kink and so stop the oil flow. The cables were therefore laid full of water, which kept them in-

NOTE: Based on material and photographs provided by the British Information Services, New York, N. Y.



"HAMEL" PIPE STORED IN 3/4-MILE LENGTHS READY FOR WINDING ON THE "CONUNDRUMS," THE HUGE SEAGOING "BOBBINS" WHICH LAID THE PIPE LINES BY ROLLING IT OFF AS THEY WERE TOWED ACROSS THE CHANNEL

(About 200 miles of pipe can be seen in this picture.)

flated. The pipe line was called the HAIS (Hartley-Anglo-Iranian-Siemens).

Meanwhile another pipe line was invented by B. J. Ellis, chief oilfields engineer of the Burma Oil Company, and H. A. Hammick, chief engineer of the Iraq Petroleum Company. This second pipeline, named "Hamel," was composed of 20-ft lengths of 3-in-diam steel pipe which could be welded automatically into any length and could be wound onto a drum like thread on a spool, if the drum were 30 or more ft diam. To use this, the Admiralty's Director of Naval Construction designed H.M.S. *Persephone*, converted from a hopper barge to a craft with a great wheel rotating in trunnions on her deck and capable of carrying many miles of the 3-in. Hamel pipe and paying it into the sea. From this a second idea was developed, i.e., a floating drum capable of carrying the full length of pipe which might be required for the Channel crossing, and which could be towed by tugs like a large bobbin paying off the pipe as it went.

FACTORY SET UP TO MANUFACTURE PIPE

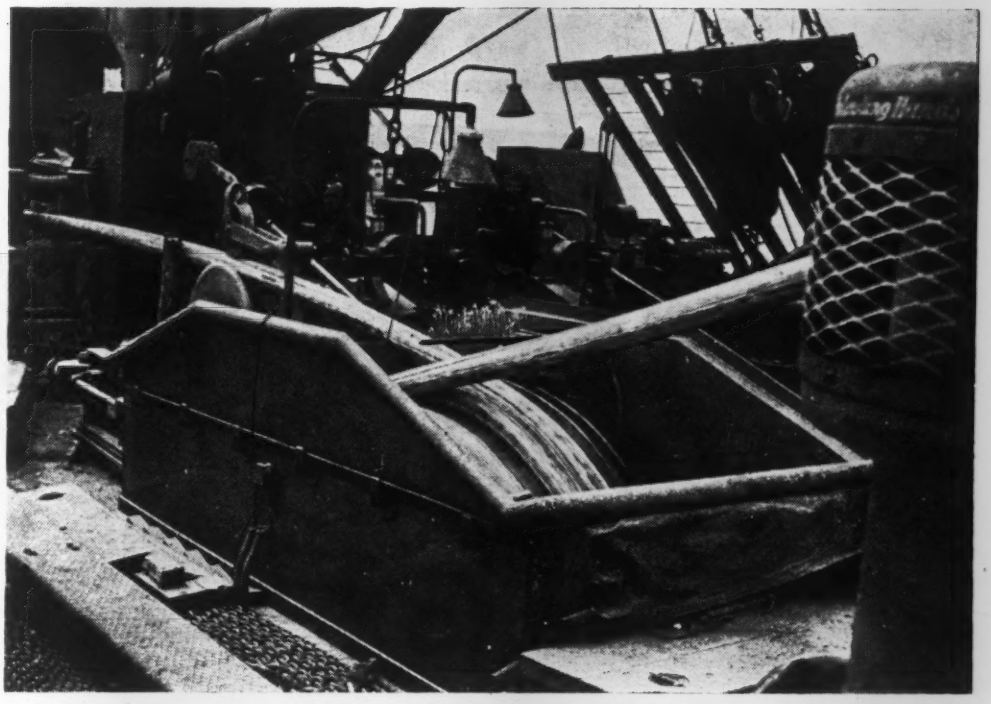
Within a few months, a special factory at Tilbury, in the Thames Estuary, was equipped for welding 20-ft lengths of the Hamel pipe into 4000-ft lengths at a rate of 10 miles daily, with facilities for storing the lengths to a total of 350 miles a day. Shortly afterward a duplicate factory was established in case the first should be bombed.

The floating drums, called "conundrums" (or "conuns" for short) were moored into deep water at the end of the pipe racks, so that the 4000-ft lengths might be welded into a continuous length of 30 or more miles, and wound onto the conuns while they rotated. A conun is 90 ft long, over 50 ft in diam, and when fully wound weighs 1600 tons, or the weight of a destroyer. It can carry 70 miles of pipe line. The drum around which the pipe is wound is 40 ft in diam and 60 ft long.

"FORCE PLUTO" FORMED TO LAY PIPE LINES

After the successful trials of the HAIS cable in April, 1943, Geoffrey Lloyd arranged that the manufacture of HAIS cable and Hamel pipe, and the co-ordination of the whole scheme, together with provision of pumping stations on the English shore, should be the responsibility of Britain's Petroleum Warfare Department. The work then developed in conjunction with the Admiralty Department of Miscellaneous Weapons Development, while the Royal Navy accepted the responsibility of laying the pipes at sea. Thus "Force Pluto" was formed, under Capt. J. F. Hutchings of the Royal Navy, composed of ships of all sizes from 10,000 tonners down to barges and motorboats manned by British Merchant Navy seamen. The Force was placed under the command of Admiral Sir Bertram Ramsey, Allied Naval Commander.

Force Pluto's main base was Southampton, England, with a secondary base at Tilbury. The Force numbered 100 British Merchant Navy officers and 1000 men. In addition to H.M.S. *Holdfast*, three merchantmen were fitted with the cable-laying machinery. Two could carry 100 miles and one, 30 miles of HAIS cable. Thames barges were converted for handling the cable at the shore ends, where large ships could not operate. Six conuns handled the Hamel pipe. New pipe lines were run from the British system to take the gasoline to the coast, and special high-pressure pumping stations were cleverly camouflaged. One of these was in a row of blitzed houses at Sandown, on the Isle of Wight; another was in an old fort built



THE 3-INCH "HAIS" CABLE PASSING ROUND THE CABLE DRUM OF THE LIBERTY SHIP "LATIMER" DURING THE LAYING OPERATION
(This shows the flexibility of this continuous-built pipe.)

in the 1860's against possible invasion by Napoleon III; and others were in a modern amusement park and in seaside villas at Dungeness.

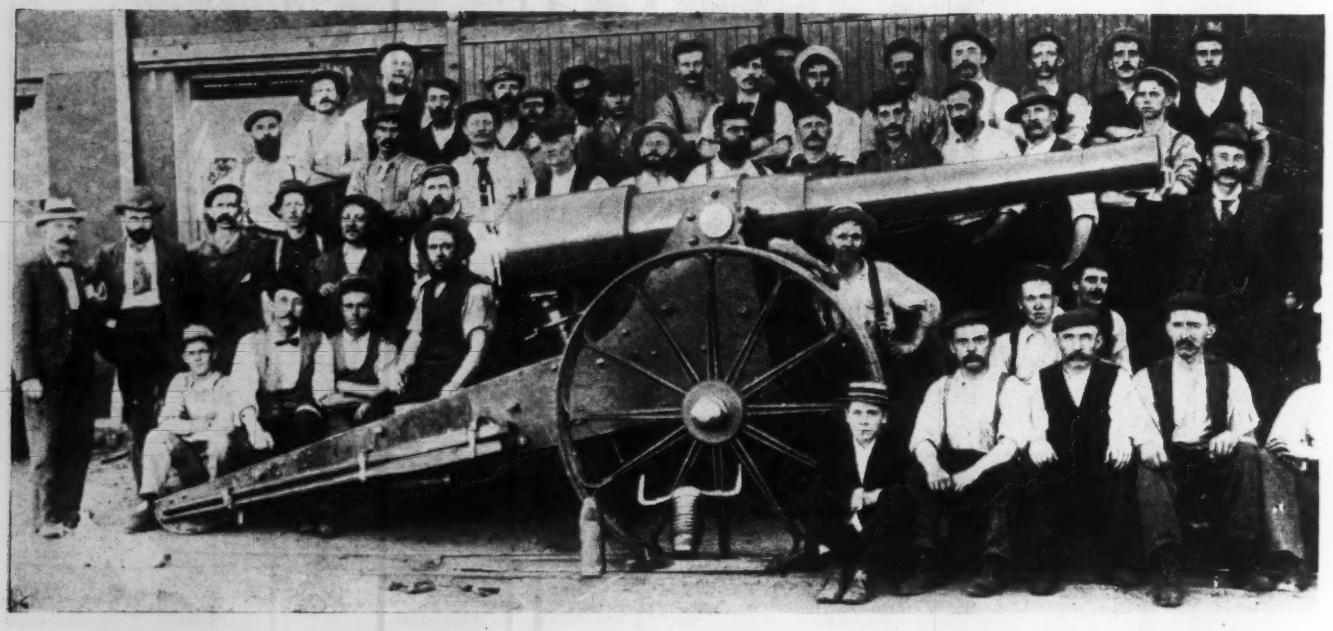
GASOLINE SUPPLIED TO ALLIED ARMIES

"Operation Pluto" began as soon as the mines had been swept to the approaches to the tip of Cherbourg Peninsula. The lines running from the Isle of Wight to Cherbourg took 10 hr to lay and conveyed gasoline to the United States Armies. The lines established as soon as Boulogne was captured, from Dungeness to Boulogne, took 5 hr to lay and transported gasoline to the British 21st Army Group. Men of the Royal Army Service Corps pumped oil to cleverly concealed pumping stations on the French coast, frequently in rough weather, having to wade up to their necks to bring in the end of the line from the ships. An R.A.S.C. petroleum unit also maintains direct contact with the French terminals by cross-Channel wireless-telephone, thereby instantly detecting and reporting variations in the quantities delivered.

Paying tribute to this British engineering feat, Prime Minister Churchill said: "A large part of the Allied Expeditionary Force has been supplied with petrol by this unique method, which provides for petroleum the same kind of facilities upon a hostile shore that the Mulberry (prefabricated) harbors provided for general military stores. Operation Pluto is a wholly British achievement and a feat of amphibious engineering skill of which we may well be proud."

General Eisenhower expressed his "warm appreciation of the work the Pluto pipe lines have done in supplying United States as well as British forces in their drive into Germany."

BRITISH TROOPS INSTALLING THE T-UNION VALVE AT BOULOGNE FOR THE FIRST PIPE LINE IN OCTOBER, 1944



"LONG CECIL" AND THE MEN WHO BUILT IT
(George Labram stands at the muzzle.)

LABRAM *and the* "LONG CECIL"

A Tale of Yankee Ingenuity

By COL. C. E. DAVIES

SECRETARY, THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. MEMBER A.S.M.E.

GEORGE LABRAM in a few years in South Africa marked up a record of ingenuity and mechanical accomplishment. His most spectacular achievement was the building of the cannon *Long Cecil* during the siege of Kimberley in the Boer War. Without experience in cannon design, using the materials available in the diamond-mine shops, and depending on information in an encyclopedia and current periodicals, Labram in twenty-four days constructed a 4.1-inch gun that performed well in the defense of Kimberley.

LABRAM'S EARLY LIFE

Labram was born in the United States about 1863, his father having been an engineer in the copper mines of the Lake Superior District. After varied experiences in mining in the United States and Mexico, he went to Kimberley in South Africa in 1893 to install a crushing and concentration plant at the De Beers Consolidated Mines, Ltd., of which Cecil Rhodes was chairman and Gardner F. Williams, general manager. On the completion of the construction he took charge of the plant. Later he was made mechanical engineer of the company and in 1898 chief mechanical engineer.

Mr. Labram's work has been described at some length by three writers. A two-volume story, "The Diamond Mines of South Africa" by Gardner F. Williams, general manager of the De Beers Consolidated Mines, Ltd., devotes many pages to Labram and the *Long Cecil*. Colonel Sir David Harris in his "Pioneer, Soldier, and Politician" fills in additional details. Edward Goffe, chief draftsman at De Beers and Labram's right hand during the building of *Long Cecil*, described the gun in a paper presented June 28, 1900, at a joint meeting of The Institution of Mechanical Engineers and The American Society of Mechanical Engineers. The gun aroused the interest of the Americans and as a result, a number of models of *Long Cecil* were built by Pratt and Whitney. One of these models is now located in the Office of the Chief of Ordnance. Another is in the office of The American Society of Mechanical Engineers.

KIMBERLEY BESIEGED

Kimberley, a community of 50,000 in the midst of the diamond mines, was besieged on Oct. 14, 1899. The facilities and personnel of the mines were immediately called upon to prepare the town to withstand the siege. Labram was called on to build an emergency cold-storage plant for preserving the meat supplies. This he did in four days by insulating a small storehouse and installing a steam ice-making machine. The water supply was cut off by the Boers and Labram made an emergency connection with a mine water supply which provided ample water throughout the siege.

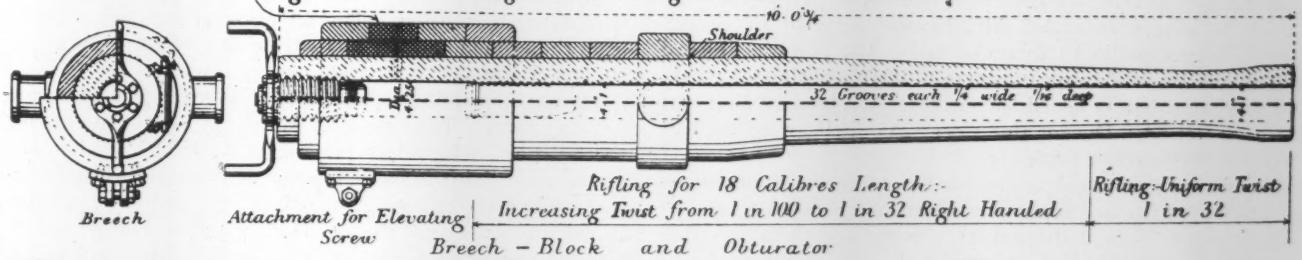
The garrison of Kimberley consisted of five companies of infantry, a small unit of engineers, and a battery of artillery

The substance of this article appeared in *Army Ordnance*, March-April, 1945, pp. 258–259.

CONSTRUCTION OF "LONG CECIL" GUN.

Position of Vent Tube while radial venting was used through Rings which burst

Fig. 2. 4·1 B.L. *Siege Gun "Long Cecil."* *Scale 1/20th*


10·0¾
Shoulder
32 Grooves each ¼ wide ⅛ deep
Breech
Attachment for Elevating Screw
Rifling for 18 Calibres Length:-
Increasing Twist from 1 in 100 to 1 in 32 Right Handed
Rifling-Uniform Twist 1 in 32

Breech – Block and Obturator

Fig. 3. *As First Made*

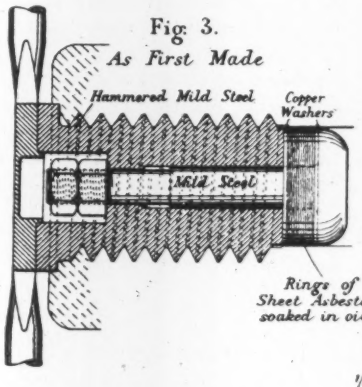
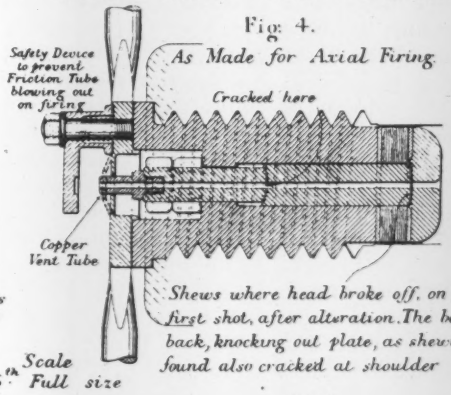


Fig. 4. *As Made for Axial Firing*


Safety Device to prevent Friction Tube blowing out on firing
Cracked here
Copper Vent Tube
Shews where head broke off, on firing first shot, after alteration. The bolt drove back, knocking out plate, as shewn, and was found also cracked at shoulder

Scale 1/6th Full size

Fig. 5. *As Finally Made.*

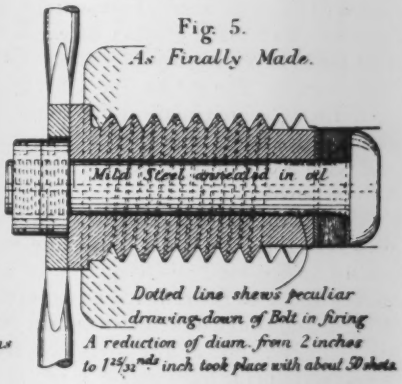
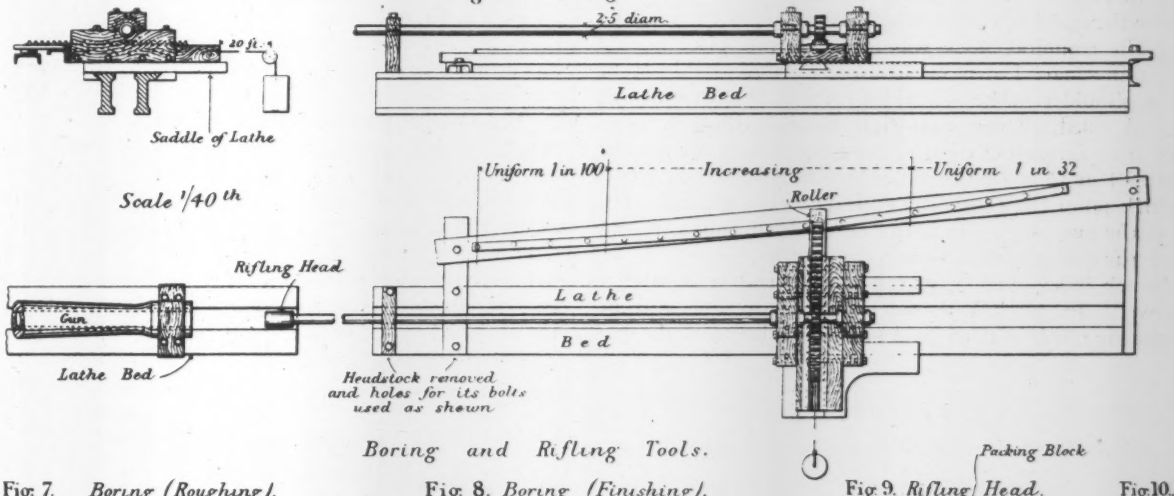

Mild Steel annealed in oil
Dotted line shews peculiar drawing-down of Bolt in firing
A reduction of diam. from 2 inches to 1 25/32nds inch took place with about 20 shots

Fig. 6. *Rifling Device.*



Boring and Rifling Tools.

Fig. 7. *Boring (Roughing).*

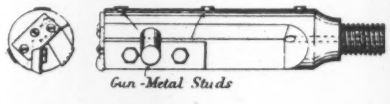


Fig. 8. *Boring (Finishing).*
Similar Tool also used for Powder Chamber.

Fig. 9. *Rifling Head.*

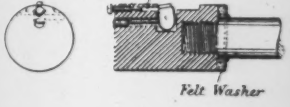
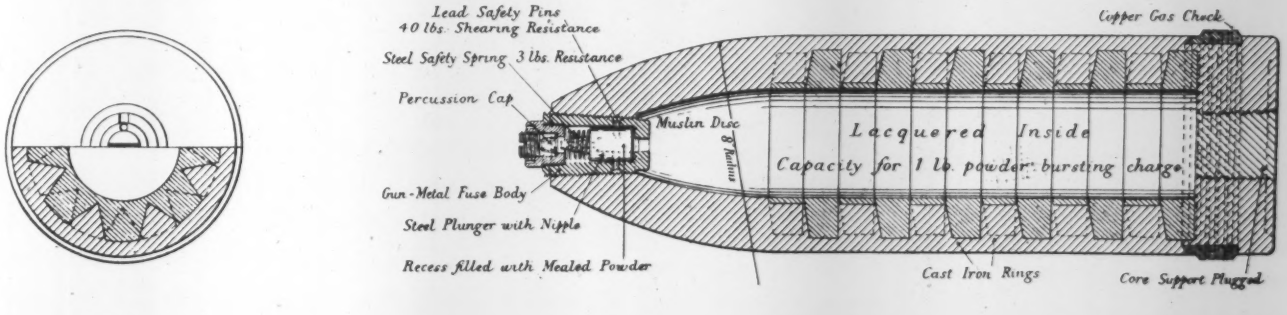


Fig. 10. *Drill.*

Scale 1/10th Full size

Ring Shells made at the workshops of the D.B.C. Mines during the Siege of Kimberley, 1899-1900.

Fig. 11. *For 4·1 inch B.L. Siege Gun "Long Cecil."*



Reproduced from Transactions of The Institution of Mechanical Engineers, London, England. Engraving by courtesy of Army Ordnance

armed with six 2.5-in. seven-pounder muzzle-loading guns. As the Boers possessed a fifteen-pounder, successful defense required a more powerful weapon.

On Christmas Day, 1899, when it was apparent that the siege would be long drawn out, Mr. Rhodes directed the building of a bigger gun and Labram started. The gun was finished on January 19, 1900, after twenty-four days' continuous work, and was immediately tested and ranged. On January 23 it was put into action. During the siege, 255 shells were fired at ranges of 5000 to 6000 yards.

The gun, the method of machining, and the ammunition are shown in the accompanying illustrations taken from Mr. Goffe's paper (Figs. 2 through 11). Some additional information will be of interest. Fortunately, the diamond mines had a large stock of black powder of various grains which had been used for blasting in the open mines. Using information in the Encyclopedia Britannica and current engineering periodicals, preliminary approximations led to the decision to build a gun of about 4 in. bore, shooting a projectile of from 25 to 30 lb and with a chamber powder pressure of about 50,000 psi using 5 lb of powder.

A billet of shafting steel $10^1/_2$ in. in diameter and 10 ft long was available. It had a "breaking strain of 27 to 30 tons per square inch giving an elongation of 20 to 35 per cent in eight inches and a 40 per cent reduction in area." This was turned, drilled, and rough-bored to form the inner tube. To reduce the stress in the tube at the breech, breech rings were necessary. These were made from bars of 6-in. $\times$ $2^1/_2$-in. Lowmoor iron (a high-grade wrought iron), formed, welded, turned, bored, and shrunk into place. Nine rings were put on next to the tube and four in the outer row were shrunk over the inner row at the breech. The trunnion block was forged in one piece from a block of 6-in-square Lowmoor iron and shrunk on the tube against a shoulder. The assembled tube was then finished, bored, and rifled. Thirty-two right-handed rifling grooves were cut at an increasing twist of from 1 in 100 at the powder chamber to 1 in 32 at a point about two feet from the muzzle, from which point the twist was uniform to the muzzle. The caliber of the gun was 4.1 in. The finished gun tube is shown in Fig. 2; the rifling tools in Figs. 6 through 10.

The breech block, Fig. 3, was made of mild steel with a full screw $^3/_4$ in. pitch V-thread flattened top and bottom. The obturating bolt was of mild steel annealed, and the pad was of asbestos soaked in oil and contained between copper washers.

The carriage was built of four $^1/_4$-in. plates cut to shape and riveted in pairs. The wheels, from a portable engine, were spaced five feet apart. The trunnion centers were five feet from the ground and five inches behind a vertical line through the wheel centers.

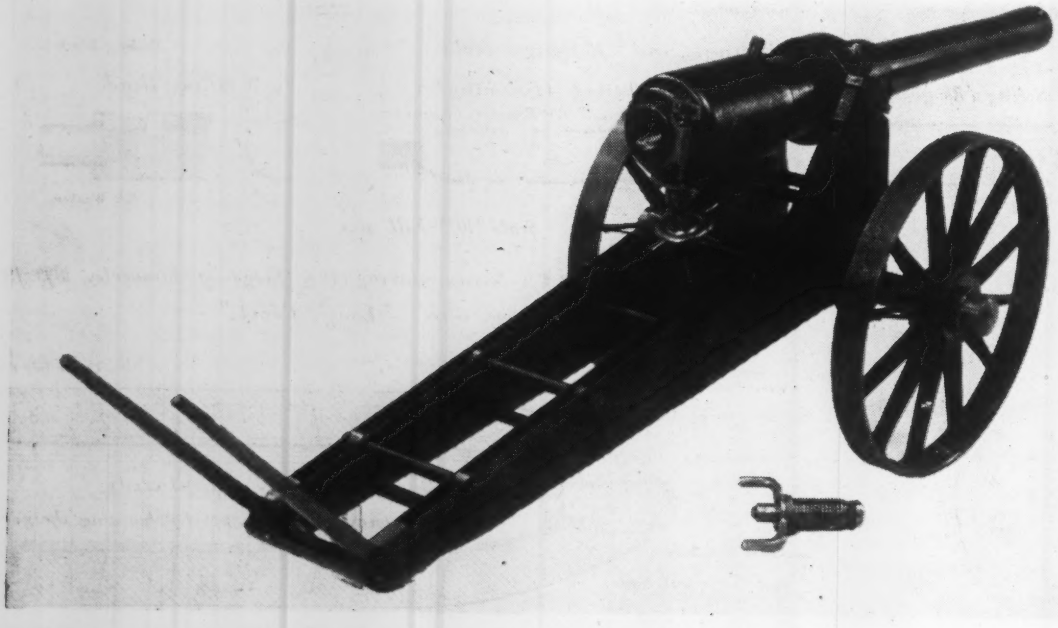
The shell, which weighed 29 lb, was made in both common and ring form. The ring form, shown in Fig. 11, was familiar to the shops which had previously made the smaller seven-pound size. This ingenious fragmentation type was made by placing cast serrated rings on a clay core and casting the rest of the projectile over them. The percussion fuse designed by Labram contained a plunger filled with mealed powder, held by a safety pin, which upon impact moved forward, sheared the pins, and encountered a percussion cap, ordinarily used in sporting shotguns. The propelling charge was contained in cartridge bags of wool serge. The bursting charge was one pound of black powder.

As in all new devices, operating difficulties cropped up. One morning, firing a six-pound charge in a cold gun, three breech rings burst, Fig. 2. The difficulty was diagnosed as gas leakage through the radial vent caused by faulty welding. The rings were replaced, the radial vent was plugged, and an axial vent was bored through the breech block. The first shot after this alteration broke off the head of the obturator, Fig. 4. The next bolt made was oil annealed and it served throughout the siege, Fig. 5.

SIEGE LIFTED

Long Cecil's fire power caused much confusion among the Boers and as a countermeasure, a *Long Tom* firing a 95-lb shell was brought in by the Boers on February 8. It continued firing during the ninth and the last shot of the day at about 6 p.m. crashed through the roof and three brick walls of the Grand Hotel into the room of George Labram to kill him. Labram was buried at night on the tenth with full military honors and the Stars and Stripes draped over his coffin. On the fifteenth the siege was lifted by a British column.

Those who have written about the *Long Cecil* pay high tribute to George Labram's great mechanical skill and general resourcefulness, his inventive genius and untiring energy. He died at the age of 37. In the words of Sir David Harris, "America can be proud to claim him as her son."



MODEL OF "LONG CECIL" AT A.S.M.E. HEADQUARTERS

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Tool Control at Puget Sound Navy Yard

COMMENT BY N. H. BRISSON[1]

The writer's comment on this paper[2] is intended to confirm the feasibility of the tool-control system described. Historically, the central-tool-shop system has been considered the most successful means of conducting the Navy Department's program for the conservation of cutting tools and high-speed tool steels. Accordingly, since November, 1942, a central tool and service shop has been operative at the U. S. Navy Yard, Portsmouth, N. H., in emulation of the Puget Sound precedent. During the past two years, advantages through this organization have accrued in connection with the introduction of high-productive carbide and cast-alloy tooling, uniform machine grinding conducive to longer life between regrinds, the use of centralized inventory as a fundamental in yard production strategy, and basically in providing the best tools most quickly for each specific mechanical operation.

The author strikes the heart of the problem in his analysis of concentration and specialization; transmuting what had formerly been the general headache of everybody into the specific responsibility and opportunity of one organization of specialists. For example, we cite shipboard drilling. Specialists included in a central tool and service shop should basically provide ventilation, light, air, drinking water, and telephone either at or near the shipboard location; provide pneumatic machines periodically overhauled and oiled, and a special setup box of jigs, fixtures, cutting drills, counterbores, spotfacers, etc., designed, built, and ground for that specific drilling operation. The driller has nothing to do but drill.

This note of confirmation of the central-tool-shop idea must be construed as a personal rather than an official viewpoint, which developed during the writer's experience in setting up the Portsmouth tool shop in "pseudo-imitation" of the author's excellent shop at the Puget Sound yard.

[1] Lieutenant, U.S.N.R., Office of Industrial Manager, U.S.N., Seventh Naval District, Miami, Fla.

[2] "Tool Control Practiced at the Puget Sound Navy Yard," by W. E. Ainsworth, MECHANICAL ENGINEERING, vol. 66, 1944, pp. 631–637.

COMMENT BY JOSEPH GESCHELIN[3]

It is of great interest to find that Puget Sound Navy Yard has adopted tool-control practices which compare favorably with those in the mass-production industries, such as the motorcar industry. The author is to be complimented upon his knowledge and experience with advanced practices and for the ability to carry out the principles in a reorganization of a large shipyard.

The author mentions as a goal the principle of having all single-point cutting tools ground by specialists. It is assumed from the text that this is being done, at least to an extent. Therefore, the inference would be that the goal would be a complete centralization of tool-grinding facilities. Naturally, anything short of this would not accomplish the purpose of the author.

What is the procedure for determining when tools require reconditioning?

COMMENT BY F. O. HOAGLAND[4]

During a recent visit to the Puget Sound Navy Yard, the writer was quite impressed with the facilities, including the great quantities of modern machine tools and the orderly appearance of the shops, which latter means efficiency and reflects upon the quality of the work being turned out. It was not realized, however, to what extent tool control was being practiced until reading the subject paper.

The magnitude of the undertaking can be realized when it was found advantageous to develop special machines for sharpening flat chisels and twist drills. Even if the actual savings in time and money cannot be determined, the writer feels quite certain that it is considerable, as it is well known from experience that an operator may fool away half an hour in sharpening a tool of that type unless he has the necessary experience and willingness to do it rapidly. It is also interesting to note how carefully worn-out cutters made of high-speed steel and tungsten carbide are cared for, and how they are converted into useful tools instead of being thrown on the scrap pile. Great care is evidently also used in preserving the cutting edges of the tools while in storage, so the operator can have the full benefit of a sharp tool.

Last, but not least, it is interesting to note that the Navy Yard supplies each journeyman with a toolbox containing a set of standard tools. This surely is out of the ordinary practice and gives him an opportunity to do better work in shorter time than he otherwise could do.

[3] Detroit Editor, Chilton Publications, Detroit, Mich.

[4] Master Mechanic, Pratt & Whitney, West Hartford 1, Conn.

COMMENT BY F. W. LUCHT[5]

For years, we not only have recommended but have assisted in the installation of what the author has referred to as a "centralized tool control." We have found that this was the only means to obtain maximum results with greatest economies from all carbide tools. It is of utmost importance that this carbide-tool control system should be the specialized activity of an individual who has recognized authority throughout the entire plant. He should be responsible for the design, the application, and the grinding of all carbide cutting tools.

In the larger plants, you will find that this carbide specialist has at least three assistants, among whom the responsibility of design, application, and grinding has been divided. In other plants, this may be the work of one man only. In very small plants, it may be a part-time activity only. But in every case, maximum effectiveness depends on the services of a man or men who have specialized training in all phases of good carbide-tool practice.

We recommend that these men be encouraged to attend the training school of the writer's company, where as a service to industry we instruct them in the following:

1 The essential characteristics of cemented carbides.
2 Designing of cemented-carbide tools.
3 Brazing of cemented-carbide tools.
4 Grinding of cemented-carbide tools.
5 Putting cemented-carbide tools to work.

Most plants which have taken advantage of such a training program have found that it promotes increased production through longer tool life. Everyone is working toward a common goal with

[5] Development Engineer, Carboloy Company, Inc., Detroit, Mich. Mem. A.S.M.E.

a minimum amount of effort. Each man becomes a specialist along his particular line of endeavor. This all tends toward a reduced tool cost per finished part because it encourages:

1 The use of standardized tool shanks.
2 A study of tool shapes and cutting angles.
3 Reduction of tool inventory.
4 Job analysis.
5 An analysis of grinding technique.
6 Operator education.
7 An analysis of correct speeds and feeds and the maintenance of them.
8 Fixture analyses to reduce loading and unloading time.
9 A tool design which is not only simple to make but also easy to grind.
10 The use of a system of records which is vital in any centralized tool control.
11 Proper care and handling of tools.
12 The use of toolholders and tool-setting gages, which not only reduces tool-changing time but also makes tool changing so easy that there is no reason for operators to run tools too long. We all know that when tools are run too long, the grinding department carries the burden.
13 A plan in which every machine operator has all the tools he requires throughout his shift period at hand at all times.

These ideas and many others should always be kept in the foreground in production shops. Too often there is a tendency to forget that the entire toolroom in any organization is a high-grade service department, and its sole purpose is to assist in keeping a uniform flow of finished parts from the production line.

The author is to be complimented for the work he has done, and nothing but success can result from a tool-control system such as he has outlined.

COMMENT BY R. W. RIGHTER[6]

The various co-ordinated organizations outlined in the paper are set up to insure that the proper tool in the best operating condition is available when needed, and it has been noted at the Puget Sound Navy Yard that this results in excellent low-cost tooling.

Time or space permitting, the author would undoubtedly have emphasized more strongly the advantages ensuing when proper importance is placed on cutting tools. Often an expensive machine tool is purchased, carefully and accurately installed, and then abused and worn out before its time, due to the improper selection, grinding, and application of the comparably inexpensive cutting tool. The fallacy of this is obvious, but of equal importance to the improper functioning of the machine tool are the wasted productive man-hours that result from incorrectly ground tools or misapplied tools. As part of his tool-control organization, the author is known to have certain specialists who follow up recurring tool failures to correct the application, or change tooling if necessary, with an aim toward maximum production at minimum tool costs.

[6] Senior Engineer (Industrial), Bureau of Ships, Navy Department, Washington, D. C.

COMMENT BY M. G. TULL[7]

This paper was very interesting personally as the writer was assistant shop superintendent at the Puget Sound Navy Yard during the period of greatest expansion. There was ample opportunity to see the centralized tool control in action when tools were critical and hard to obtain.

The author is doing an excellent job in developing new ideas and has built up a fine organization to take care of the many problems encountered in a large plant.

Like the paper itself, any opinions which the writer may express must be considered as private ones and not be construed as official or reflecting the views of the Navy Department.

As is well known, there is a great deal of opposition to centralized tool control. The old mechanics like to grind their own tools, and the various shops prefer to handle their own toolrooms. Nevertheless, as the author ably points out, there are tremendous savings in a well organized central tool control.

The argument is sometimes advanced that after a tool has been correctly ground, a chisel for instance, the mechanic will regrind it before using it. There are cases when this will be done. However, the better the tool is ground the less frequently this will occur.

The automatic chisel grinder developed at Puget Sound will grind one chisel just the same as every other one to the exact shape that has been determined to be best. Then each chisel receives a surface-hardening which further improves its ability to cut and stay sharp longer. There has been some misunderstanding of this hardening process. It does not replace the heat-treatment after forging but is an additional thin surface hardening applied after each grinding. With chisels ground like this, it will not be long until all mechanics realize that they cannot do as well.

The Munro drill grinder is another development of the Puget Sound central toolroom. Its real value lies in its ability quickly and easily to repoint a drill to the exact shape desired, grinding both lips simultaneously. With sufficient skill the drill point used can be ground in other ways but the Munro grinder produces the point quickly and easily and requires little or no skill to operate.

The figure of 400 per cent increase in the number of holes drilled between grinds seems fantastic. However, every test which we ran showed that to be the approximate figure. The worth of a drill grinder can only be measured comparatively if machines are available to grind and regrind each drill on first one machine and then the other. A carefully controlled test, run under the writer's supervision, using several different kinds of drills and grinding each drill on each grinder showed approximately the same results. The time required to grind the drills on each machine was also measured. This showed a big saving of time by using the Munro grinder, 0.9 min against 1.55 min.

It is not difficult to get mechanics to use drills without regrinding them when every drill issued from the toolroom will cut curls, exactly alike from the two lips. This is so unusual that for emphasis it will be repeated. Every drill ground on a Munro grinder will cut curls which are identical twins.

Naturally, it is expensive to develop machines such as these, but with central grinding rooms and the thousands of tools used in large plants, the savings in materials and time are so great that the cost of the machines becomes insignificant.

As the methods of grinding have been improved, there has been a noticeable decrease in the arguments against a central toolroom, and a marked decrease in the number of mechanics who want to grind their own tools.

Another one of the writer's duties at Puget Sound was the approval of all purchases of small tools and grinding wheels. The card-index system of inventory, showing when to reorder each item, was invaluable. Having one order for an item used in many shops instead of a separate order for each shop saved many hours time, particularly when so many different items had to be ordered. Another advantage of the central tool control is that only one stock of extra tools for emergencies is required as tools can be shifted from shop to shop according to the requirements.

The only conclusion the writer can draw from the Puget Sound setup is that a well-organized and well-run central tool control is very profitable and a big help to any large plant.

[7] Lieutenant Commander, U.S.N.R., Industrial Department, Philadelphia Navy Yard, Philadelphia, Pa.

AUTHOR'S CLOSURE

The author had a dual purpose in mind in preparing this paper. In his opinion centralized tool control has a great many advantages over methods commonly practiced at many industrial plants.

Knowing that this covered a very large and important field, it appeared desirable to place this subject before as many engineers as possible, for their comments. The discussion following the presentation of the paper was bound to encourage management to become more tool-conscious as well as to bring to their attention the important part tool control plays in increasing production.

The more discussion concerning this subject, by engineers who know the problems involved, the better. It will be of the greatest assistance to those seeking some standard policy of tool control. In reviewing the comments made by engineers from large industrial plants, the procedure as outlined was received favorably, thereby assuring the author it had merit enough to warrant using it as a foundation for further improvement in tool control. A large percentage of the procedure used at this yard has been gathered little by little from other industrial plants, screening out that which did not fit this activity, and using what was considered the best of many suggestions.

To assist the author in compiling information as to the tool control practiced at the various naval activities, and industrial plants, a representative group of questions was prepared. The answers obtained from the numerous industrial plants visited have proved very helpful in improving the tool control at this yard. In visiting a plant, the author endeavored to get the answers to at least 150 of such questions as the following: What method is used in storing tools? Are toolrooms located close to where tools are used? Do tools contact each other where it is possible to nick them? What is the condition of tools in a rack? Are they sharp? Are cutting edges burnt? Does the quantity appear to be satisfactory? Are the fast-moving tools close to issuing windows? Are bolts, clamps, and blocks available and in good condition?

It is the author's opinion that the ultimate could be attained, as far as tool control is concerned, if through some medium such as MECHANICAL ENGINEERING, questions and answers could be published from many industrial plants. One question might be, "Are tools purchased by cost or production records?"

Many suggestions would be forthcoming that would greatly assist those industrial plants which are interested in developing a uniform procedure in handling tools. As more answers become available, a summary could be compiled that would give a fairly complete picture as to the ideal method of tool control.

W. E. AINSWORTH.[8]

[8] Master Mechanic, Tool Shop, Puget Sound Navy Yard, Brewerton, Wash.

Welding Electrode Standards

TO THE EDITOR:

Industry in general and the welding industry in particular, are and have been greatly handicapped by the lack of a real technical standard covering elect odes.

True it is, there have been in existence for some years a so-called standard which actually might be termed a "buyers' guide," known as "Tentative Specifications for Iron and Steel Arc Welding Electrodes" published by the A.W.S. However, even in this long and complicated "buyers' guide" there are so many discrepancies with ambiguous and contradictory statements that it is rendered entirely unsatisfactory. Let me cite a few examples.

To qualify any electrode for any classification, the tests are so complicated and so costly as to render them useless in manufacturing practice. They are too costly to be repeated periodically as a check on manufacturing standards.

Tests are required on all sizes of $^{5}/_{32}$ in. and larger; but note—no tests are required on $^{1}/_{8}$ in. and smaller, so why have tests on *each* larger size?

A manufacturer cannot use the same electrode for two or more classifications; this in spite of the fact that the ideal electrode, of course, is one which would fulfill all classifications.

Then there are specifications as to the electrical resistance of the coating which certainly has nothing to do with the performance of the electrode.

Also it says:

> The coating shall not have scabs, blisters, abnormal pockmarks, bruises, or other surface defects that shall be injurious.

Just what is injurious?

These are only a few of the idiosyncrasies of this "buyers' guide." Therefore, it can readily be seen that what is needed is a simple, easily understandable standard which would enable a manufacturer to manufacture to such standards consistently and would enable the purchaser to readily and easily test the electrodes if he wished to do so, to see if the manufacturer was conforming to the standards.

Since there is no need for a weld stronger or better than the material to be welded, I suggest for mild steel which covers 90 per cent of the requirements, a simple standard something as follows:

> The electrode shall be of such characteristics that it will withstand the following tests to be made any time a buyer might desire:
>
> (*a*) A weld made in $^{3}/_{8}$-in. or $^{1}/_{2}$-in. plate of mild steel, planed to the same thickness as the parent metal, must break outside of the weld when pulled in a standard tension machine.
>
> (*b*) On a section from the same plate mentioned in (*a*), welds to be bent in any way desired and elongation of 25 per cent in the outside fibers must show no fracture.

It is quite evident that an electrode which will perform as indicated in these two tests will give a weld equal in physical qualities to the plate.

With such a weld obviously the matter of porosity is of no consequence. However, if it should be desired to cover the question of porosity, a simple test could be made as follows:

> A fracture shall be made through the weld. On a straight line through the fractured weld there shall be voids of no more than 5 per cent cumulatively.

There is no question but that an electrode which will withstand the foregoing very simple tests will be satisfactory in welding mild steel, so why complicate matters?

It seems to me that this is a question to which the Filler Metal Committee of the American Welding Society should give proper attention.[9]

J. F. LINCOLN.[10]

[9] It is understood that a new edition of the A.W.S.-A.S.T.M. filler-metal specifications will be issued in August, 1945.

[10] President, The Lincoln Electric Company, Cleveland, Ohio. Mem. A.S.M.E.

Applying Engineering Principles to Design of Welded Joints

TO THE EDITOR:

The criticism of J. F. Lincoln's article (September, 1944, issue, page 614), by E. Paul DeGarmo, which appeared on page 136 of the February, 1945, issue of MECHANICAL ENGINEERING, is perhaps a little unjust. As in many other controversies, there is much to be said on both sides of the question.

Professor DeGarmo's bending specimens made of $^{3}/_{4}$-in-thick plate, which broke in the welded bead, cannot be considered "obvious contradictions" of Mr. Lincoln's statement, for the following reasons:

1 The welding bead was laid on one side of the steel plate. As it cooled and shrunk, tensile stresses were induced in it (as well as on the other side of the steel plate), and compression stresses were simultaneously induced in the metal between, at equilibrium.

2 Then a "nick" was made in the bead. If this nick was made with a mill-

ing cutter, or the like, perhaps no additional internal stresses were introduced. But, if it was made with a chisel, undoubtedly additional internal stresses were introduced. Possibly also a crack was started at the root of the nick.

3 The composite plate was subjected to bending which put the welded bead in tension. Being further removed from the neutral axis than the adjacent surface of the virgin plate, the bead naturally was subjected to a greater tensile stress than the plate surface.

4 Finally, with a sharp V at the root of the nick, the stress concentration there was well above unity, and the actual stress was greater than that in neighboring fibers of the bead itself.

So with initial thermal stress, possible chisel fracture, greater than the virgin plate bending stress, and stress concentration due to the shape of the notch, there is no wonder that the failure occurred precisely as DeGarmo's plate indicates.

If a plate were machined having a protruding bead of virgin metal of identical dimensions with the welded bead, and it were nicked, it is probable that a similar failure would occur.

Hence we should not quarrel about whether engineering is a more exact science than welding, but apply all the science we can muster to an engineering analysis of welded joints that we may attain that perfect state of engineering in which an exact design of a welded joint for a specific engineering application is achieved.

FREDERICK FRANZ.[11]

TO THE EDITOR:

In reference to the letter from Mr. Frederick Franz, his statements regarding the possibility of there being additional stresses induced by the notch made with a chisel are true.

It is also true that there are residual tensile stresses in the weld and that the surface of the weld bead is farther from the neutral axis than is the surface of the plate and therefore has a higher stress when a member is bent. However, these two facts are results of welding and may partially account for welds not behaving under all conditions as satisfactorily as riveted joints.

As a matter of fact, if the weld reinforcement is machined away entirely and no nick is made, such a specimen as I have described would still fail in the weld first and will not be as strong as the parent plate. We have conducted many experiments which prove this. We have also found that no nick is necessary when the weld reinforcement is left on, the ripples in the bead being sufficient notches.

[11] Consulting Engineer, 401 Chapel Street, New Haven, Conn. Mem. A.S.M.E.

Thus while Mr. Franz's comments are pertinent to the particular specimen, the illustration of which I submitted, we have other specimens which exhibit the same weakness as I described but not subject to the criticism which Mr. Franz makes.

Mr. Lincoln states on page 137 of the February issue ". . . . there has never been a failure of an insured welded joint." The failure of a joint in the Springdale Station of the West Penn Power Company is well known, having been discussed in the *Transactions* of the Society. This was a failure of an "insured" joint. It is true that the weld metal itself did not fail, but the heat accompanying welding caused a condition in the heat-affected zone of the parent metal such that failure occurred. This must be considered a failure which resulted from welding.

I am very much in agreement with the last paragraph of Mr. Franz's letter. I think it is in agreement with the last paragraph of my statement in the February issue. It only serves to emphasize that welding produces certain conditions which are not thoroughly understood and which make it impossible to predict exactly how welded structures will behave under all conditions. Our efforts should be directed toward eliminating these unknowns, not ignoring or denying them.

E. PAUL DEGARMO.[12]

Collective Bargaining at Whiting Refinery

TO THE EDITOR:

The Research and Engineering Professional Employees Association, of Whiting, Ind., and the Standard Oil Company (Indiana) signed a contract on March 12, 1945. The R.E.P.E.A. is the certified collective-bargaining agent for nearly all of the nonsupervisory technical professional employees at the Whiting Refinery. This organization was formed July 2, 1943, and was certified by the N.L.R.B. on Feb. 29, 1944. About 90 per cent of the engineers and chemists in the bargaining unit are members of the organization. The R.E.P.E.A. was the first independent organization, composed solely of technical employees at the professional level, to obtain N.L.R.B. certification. A second such organization, the Association of Professional Engineering Personnel, at R.C.A. Victor in Camden, N. J., has recently been certified and the Association of Industrial Scientists, at Shell in Emeryville, Calif., has petitioned the N.L.R.B. for certification.

The chief feature of the contract, which will be effective until March 31, 1946, is a well-defined procedure for handling questions involving salaries, hours, and other conditions of employment. This procedure culminates, if necessary, in arbitration by the U. S. Department of Labor. A friendly relationship exists between the company and the R.E.P.E.A.; the contract is evidence that this relationship will continue. Since collective-bargaining for technical employees at the professional level is a new development, much time and study by both the Company and the R.E.P.E.A. were devoted to the preparation of this contract. During the year since certification numerous others matters, in addition to the contract, have been the subject of discussions between association and company representatives. Agreements reached on several of these matters have been incorporated in the contract. One such item is a provision to encourage attendance at national meetings or committee meetings of recognized technical and professional societies. The company will grant leaves of absence with pay to each technical employee for a period up to six days per year for attendance at such meetings.

PHILIP HILL.[13]

[12] Associate Professor of Mechanical Engineering, University of California, Berkeley, Calif. Mem. A.S.M.E.

[13] Chairman, R.E.P.E.A. Public Relations Committee, Whiting, Ind.

Safety in Air and Rail Travel

TO THE EDITOR:

Under the subject of safety in the paper[14] C. C. Furnas, the author, quotes safety figures as follows:

One death per 45 million passenger-miles, commercial planes

One death per 36 million passenger-miles, private automobiles

Let me suggest that to this record should be added the railroad record:

1943 One death per 332,000,000 passenger-miles

1942 One death per 482,000,000 passenger-miles.

That is to say, fatalities by plane are still several times those on the railroads. In view of the well-known irresponsibility of the average private-car operator, commercial-plane operators have much room for improvement.

The figures given for rail travel do not specify what year they cover but were evidently for the low year 1939—22,713,000,000 passenger-miles. In 1942 the railroads reported 53,680,000,000 passenger-miles, in 1943 this figure was 87,842,000,000 and in 1944 approximately 96,000,000,000.

W. D. BEARCE.[15]

[14] "The Next Twenty-Five Years in Aviation," by C. C. Furnas, MECHANICAL ENGINEERING, vol. 67, 1945, pp. 309–312.

[15] Erie, Pa.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Reconnaissance

ENGINEERING PREVIEW: An Introduction to Engineering Including the Necessary Review of Science and Mathematics. By L. E. Grinter, Harry N. Holmes, H. C. Spencer, Rufus Oldenburger, Charles Harris, R. G. Kloeffler, V. M. Faires. The Macmillan Company, New York, N. Y., 1945. Cloth, 6 × 9¼ in., 581 pp., 415 figs., tables, $4.50.

REVIEWED BY ALLAN R. CULLIMORE[1]

"ENGINEERING PREVIEW" is a broad and a unique conception. The authors express an opinion that it may be useful in high schools in the orientation of college students, indicating also that it may be used as a text under certain conditions. The reviewer must, perforce, confess an utter lack of competency within the high-school field, but it is entirely possible that the book may be of definite value in that field.

In the engineering field, that is, in the engineering-student field, it is fair to say that it will probably be of considerable value, particularly in the reorientation of veterans who have had one or more years of college work and who, with this background perhaps half remembered and fallen into disuse, seek the engineering field again with the desire to seize upon something which particularly interests and holds them. In order to have guidance effective in this or any other field, we must, it seems, furnish some actual experiences, either in the field itself or as close to it as possible. We must provide some contacts or some material which will give information on which to base decisions. Unless this is done, guidance is based upon wishful thinking, misunderstandings, and ignorance, sometimes upon catch phrases and catch words—upon emotional urges which have not the background of realistic thinking. This book furnishes such information in an entirely competent way and in a concise, attractive, and readable form.

While the words "possible" and "probably" have been used with malice aforethought, it is *certain* that the book fills a tremendous need in another field—the field which the reviewer thinks may be the most important to cover, more important than the instruction or orientation of students. It is perhaps the most important contribution which can be made by any publication. Engineering teachers, like engineering students, need perhaps a somewhat broader horizon, need to know some things rather definitely about the broader field of engineering. We hear today much about culture in engineering—the broader outlook—and perhaps we would be safe in saying that inherent in the engineering picture there is a chance for more culture and broader horizons. The reflection of this upon the student body cannot help but be an important and constructive factor.

All engineering teachers, all engineers with the desire to broaden their knowledge and, I think, particularly young engineers with some background along rather narrow and specific lines, will find this book covers the field broadly and definitely. Not only will they find the book extremely interesting reading, but they will find themselves unconsciously turning the pages, hunting for things touching but somewhat apart from the narrow specialty which earns their daily bread. They will find themselves looking for and finding things which not only serve to give the needed information and satisfy a professional curiosity, but things which cannot help but broaden an engineer's interest in his profession as a whole and give him some idea of some fields, an exploration of which, without this book, would entail much reconnaissance and perhaps considerable search. The book is sure to be extremely valuable in this field as a broadening and cultural influence as well as a strictly technical one. If it could be so used, its influence on engineering students throughout the country would be constructive and the benefits would be considerable.

As in the case with many a book, its immediate objective may not prove to be its most important contribution. Perhaps it will serve indirectly to do many things it is not directly designed to do. Without seeming to be overoptimistic, it would seem to the reviewer that no engineer, young or old, could long remain without a copy. The reviewer has found it excellent reading, interesting reading. He has been found picking it up and reading it when there were other things which were perhaps more immediately pressing, and he looks forward to going a little deeper into some of the fields which the book opens to him and to his fellow engineers.

[1] President, Newark College of Engineering, Newark, N. J. Mem. A.S.M.E.

Books Received in Library

FLIGHT HANDBOOK, a Manual of Aeronautical Theory and Practice. Fourth edition. Flight Publishing Co., Ltd., London, S.E.1, England, 1944. Cloth, 5 × 7½ in., 212 pp., illus., diagrams, charts, tables, 7s 6d, by post 7s 10d. The various chapters of this manual not only explain first principles in simple language but also deal with the more advanced aerodynamic and structural considerations involved, so far as possible without recourse to mathematics. Gliders and airships are dealt with briefly, as well as the ordinary airplane, and stratosphere flight and other modern developments are covered. The whole text, and particularly the sections on engines and structures, is clearly illustrated by a wealth of photographs and detail drawings.

INDUSTRIAL ELECTRIC FURNACES AND APPLIANCES, Vol. 1. By V. Paschkis. Interscience Publishers, New York, N. Y., 1945. Cloth, 6 × 9 ¼ in., 232 pp., illus., diagrams, charts, tables, $4.90. The first section of this practical book covers generally the thermal, electric, and economic principles applying to all types of furnaces and appliances. The second section discusses arc furnaces and electrode melting furnaces, with special attention to ferro-alloy furnaces. Special emphasis is placed on the thermal aspects of furnace design and operation, and design principles are discussed in detail. A second volume will deal with induction, capacitance, and resistance heating.

MACHINE DRAWING, a Text and Problem Book for Technical Students and Draftsmen. By C. L. Svensen. Third edition. D. Van Nostrand, New York, N. Y., 1945. Cloth, 6 × 9¼ in., 280 pp., illus., diagrams, charts, tables, $2.50. Machine drawings are defined in this book as the result of the practical application of mechanical drawing to the representation and specification of machinery. On this basis a brief discussion of elementary principles is followed by chapters dealing with various classes of machine elements and such topics as welded and riveted construction and piping drawings. Dimensioning and machine sketching are covered in detail, and the last hundred pages are devoted to a wide variety of problems and studies.

PHOTOMICROGRAPHY, an Introduction to Photomicrography With the Microscope. Fourteenth edition. Eastman Kodak Co., Rochester, N. Y., 1944. Cloth, 5¾ × 8¾ in., 174 pp., illus., diagrams, charts, tables, $2. Beginning with description of the necessary apparatus and general optical principles, this small book surveys the process of photography through a microscope in considerable detail. The special techniques for motion photomicrography and color photomicrography are explained, and a selected bibliography is appended.

PLASTICS CATALOG, the 1945 Encyclopedia of Plastics. Plastics Catalogue Corporation,

New York, N. Y., 1945. Cloth, $8^1/_4 \times 11^1/_2$ in., 1178 pp., illus., diagrams, charts, tables, $6. This compendium of information on plastics covers a wide field and should be useful to every present or prospective user. Recent progress in the field is reviewed. Methods of identifying and testing plastics are described. The varieties are discussed at length and their qualities considered. Other sections deal with engineering design for plastics; methods of molding, extruding and casting; fabricating, finishing, and assembling; machinery; laminates, plywood, and vulcanized fiber; coatings; synthetic fibers; rubberlike plastics. A large store of useful tabulated data is included.

PRECISION MEASUREMENT IN THE METAL WORKING INDUSTRY, Vol. 2, prepared by the Department of Education of International Business Machines Corporation, published by Syracuse University Press, Syracuse, N. Y., 1944. Cloth, 8 × 11 in., 290 pp., illus., diagrams, charts, tables, $4.75. This volume covers the more advanced types of precision measuring instruments and machines used in manufacture. Chapters on surface plates, angles, comparison measurement, optical instruments, measuring machines, surface roughness, and hardness testing are included. The various instruments are described and instruction given in their use. The course is based on practical shop work and is a very definite one.

REPORT ON PROPOSED RAILROAD GRADE CROSSING ELIMINATION AND TERMINAL IMPROVEMENT FOR NEW ORLEANS, LOUISIANA, September 5, 1944. Two volumes. Godat and Heft, consulting engineers, New Orleans, La., vol. 1, 102 pp.; vol. 2, Appendices A-D, 135 pp. Fabrikoid, $8^1/_2 \times 11^1/_4$ in., many plates, tables, diagrams, charts. In preparation for a postwar program of grade-crossing elimination and union passenger terminals in New Orleans, the firm of Godat and Heft has made studies of possible solutions of the problem which are reported in these volumes. Four alternative programs are presented, with plans and detailed cost studies, and complete drawings.

SHRINKAGE AND GAS EFFECTS IN THE CASTING OF NON-FERROUS METALS AND ALLOYS. (Association Series No. R.R.A. 661.) By W. A. Baker. British Non-Ferrous Metals Research Association, London, N.W.1, England 1944. Paper, $6 \times 9^3/_4$ in., 44 pp., illus., diagrams, charts, tables, 7s 6d. The purpose of this report is to provide a survey of the results of various researches on the control of these effects, which are the most obstinate causes of difficulty in castings. Existing knowledge is summarized and practical recommendations are given. There is a bibliography.

STEAM BOILER YEARBOOK AND MANUAL, third edition, edited by S. D. Scorer. Paul Elek, Ltd., London, England, 1945. Cloth, $5^1/_2 \times 8^1/_2$ in., 569 pp., illus., diagrams, charts, tables, 30 s. The first part of this annual publication presents a descriptive review of current British practice in steam-boiler engineering. The second part contains abridgments of the principal steam-boiler papers published during the past year, grouped under the following five headings: fuel utilization, combustion appliance developments, feedwater and steam problems, fireside problems, and modern practice and developments. A book review section has been added to Part I in the present edition.

THOMAS' REGISTER OF AMERICAN MANUFACTURERS in two volumes, thirty-fifth edition, 1945. Thomas Publishing Co., New York, N. Y. Cloth, $9 \times 14^1/_4$ in., no pagination, illus., $15. This directory, over 6000 pages in size, is a guide to the manufacturers and importers of practically every commercial product. The products are listed alphabetically in the main list, with the names and addresses of manufacturers and their capital ratings.

Library Services

ENGINEERING Societies Library books may be borrowed by mail by A.S.M.E. members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any item in its collection. Address inquiries to Harrison W. Craver, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

A.S.M.E. BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly for the purpose of considering communications relative to the Boiler Code. Anyone desiring information on the application of the Code may communicate with the Committee Secretary, 29 West 39th St., New York 18, N. Y.

The procedure of the Committee in handling the cases is as follows: All inquiries must be in written form before they are accepted for consideration. Copies are then sent by the Secretary of the Committee to all the members of the Committee. The interpretation, in the form of a reply, is then prepared by the Committee and is passed upon at a regular meeting.

This interpretation is later submitted on the Council of The American Society of Mechanical Engineers for approval and then is issued to the inquirer and published in MECHANICAL ENGINEERING.

Following is a record of the interpretations of this Committee formulated at the meeting of May 25, 1945, and approved by A.S.M.E. Council on July 2, 1945.

(CASE No. 964 *Annulled*)

The annulment becomes effective February 1, 1946.

CASE No. 968 (*Annulled*)

Proposed Revisions and Addenda to Boiler Construction Code

IT IS the policy of the Boiler Code Committee to receive and consider as promptly as possible any desired revisions of the rules and its codes. Any suggestions for revisions or modifications that are approved by the Committee will be recommended for addenda to the code, to be included later in the proper place.

The following proposed revisions have been approved for publication as proposed addenda to the code. They are published below with the corresponding paragraph number to identify their location in the various sections of the code and are submitted for criticism and approval from anyone interested therein.

It is to be noted that a proposed revision of the code should not be considered final until formally adopted by the Council of the Society and issued as pink-colored addenda sheets. Added words are printed in SMALL CAPITALS; words to be deleted are enclosed in brackets [ ]. Communications should be addressed to the Secretary of the Boiler Code Committee, 29 West 39th St., New York 18, N. Y., in order that they may be presented to the Committee for consideration.

PARS. P-102(h)(4*b*) and U-68(h)(4*b*) Revise to read:

(*b*) At least one penetrameter shall be used for each exposure, to be placed at one end of the exposed length, parallel and adjacent to the weld seam with the small holes at the outer end. If there is any difference between the angularity of the radiation at the two ends, the penetrameter shall be placed at the end of maximum angularity. In special cases the inspector may require the employment of two penetrameters, one at each end of the exposed region.

PAR. P-114. Add the following:

Staybolted box-type headers for water-tube boilers may be constructed under the provisions of Par. P-186 and as shown in Fig. P-11; provided the inside width of the waterleg does not exceed 4 in., the maximum design pressure does not exceed 200 psi, and the welded joint is not exposed to the products of combustion.

PAR. P-186(b). Revise last sentence to read:

Welding done under these provisions need not be stress-relieved or RADIOGRAPHED, [X-rayed] BUT IN THE WELDING OF PRESSURE PARTS THE PROCEDURE AND THE OPERATOR SHALL HAVE BEEN QUALIFIED UNDER THE PROVISIONS OF SECTION IX FOR THE MATERIAL, TYPE OF WELD, AND POSITION IN WHICH THE WELDING IS TO BE DONE [and no qualification of the welding operator is required.]

A.S.M.E. NEWS

And Notes on Other Engineering Activities

A.S.M.E. Chicago Section Combines Technical Program With 1945 Semi-Annual Business Meeting at Hotel Stevens, June 17–19

OWING to travel restrictions the 1945 Semi-Annual Meeting of The American Society of Mechanical Engineers, held at the Stevens Hotel, Chicago, Ill., June 17–19, 1945, was attended principally by members and guests in the Chicago area, members of the Council, and committeemen whose presence was necessary to conduct the affairs of the Society. Out-of-town members were represented at the 1945 Semi-Annual Business Meeting by proxy. The total attendance registered was about 500.

The Executive Committee of the Council met on Sunday, June 17, and the Council held three sessions on Sunday and Monday. Accounts of the actions of the Executive Committee, the Council, and the 1945 Semi-Annual Business Meeting will be found elsewhere in this issue.

1945 Group Delegates Conference

A novel feature of the meeting was the holding of the Group Delegates Conference which has previously been a feature of the Annual Meeting. Conditions this year dictated the holding of the eight regional conferences of section delegates in the late spring instead of early fall and the business conducted at these regional conferences was considered at the Group Delegates Conference. Actions taken were reported to the Council and were transmitted by the Council to the Society committees concerned with the recommendations made by the Conference. These committees will discuss the recommendations and report their decisions to the Council for final action at some future date.

The 1945 Group Delegates Conference was led by J. J. Uicker, speaker, and R. P. Hahn acted as secretary, pro tem. Prof. H. L. Solberg acted as agenda chairman.

The delegates from the eight groups of A.S.M.E. sections were:

GROUP I
Senior delegate, P. A. IBOLD, Bridgeport, Conn., Bridgeport Section
Junior delegate, W. P. SAUNIER, Boston, Mass., Boston Section

GROUP II
Senior delegate, R. W. FLYNN, New York, N. Y., Metropolitan Section
Junior delegate, HERMAN WEISBERG, Newark, N. J., Metropolitan Section

GROUP III
Senior delegate, J. H. POTTER, Baltimore, Md., Baltimore Section
Junior delegate, J. C. REED, Lewisburg, Pa., Central Pennsylvania Section

GROUP IV
Senior delegate, E. E. WILLIAMS, Piedmont-Charlotte, N. C., North Carolina Section
Junior delegate, E. S. THEISS, Durham, N. C., Raleigh Section

GROUP V
Senior delegate, J. J. UICKER, Detroit, Mich., Detroit Section
Junior delegate, A. C. PASINI, 2000 Second Ave., Detroit, Mich., Detroit Section

GROUP VI
Senior delegate, H. L. SOLBERG, Lafayette Ind., Central Indiana Section
Junior delegate, OTTO E. E. ZAHN, Mishawaka, Ind., St. Joseph Valley Section
Second Alternate, K. R. HODGES, Davenport, Ia., Tri-Cities Section

GROUP VII
Senior delegate, R. G. ROSHONG, Los Angeles, Calif., Southern California Section
Junior delegate, M. B. HOGAN, Salt Lake City, Utah, Utah Section

GROUP VIII
Senior delegate, O. L. LEWIS, Tulsa, Okla., Mid-Continent Section
Junior delegate, R. P. HAHN, Kansas City, Mo., Kansas City Section

Officers for the 1946 Group Delegates Conference, elected at the 1945 Conference, were

D. R. SHOULTS, VICE-PRESIDENT, BELL AIRCRAFT CORPORATION, SPEAKER AT MONDAY LUNCHEON

(*Left to right:* Alex D. Bailey, President of The American Society of Mechanical Engineers, John C. Buckwalter, plant manager, Chicago plant, Douglas Aircraft Company, and Mr. Shoults.)

GROUP ABOUT PHOTO OF FREDERICK W. TAYLOR AT MONDAY AFTERNOON MANAGEMENT SESSION

(*Left to right:* Prof. O. W. Boston, department of metal processing, University of Michigan; W. R. Williamson, consulting engineer, Chicago; and T. S. McEwan, Vice-President, A.S.M.E., and manager, McClure, Hadden & Ortman, Inc.)

AT THE FIRST SESSION ON METAL CUTTING

(*Left to right:* W. C. DeGraff, Warner & Swasey Co., W. H. Oldacre, president and general manager, D. A. Stuart Oil Co., Ltd.; G. P. Witteman, assistant metallurgical engineer, Bethlehem Steel Company; and A. O. Schmidt, research engineer, Kearney & Trecker Corporation.)

AT THE SECOND METAL CUTTING SESSION

(*Left to right:* Lt. Col. E. G. Moffat, works manager, Watervliet Arsenal; A. W. Meyer, assistant director of design, Brown & Sharpe Manufacturing Company; and M. F. Judkins, chief engineer, Firthite Division, Firth-Sterling Steel Co.)

E. S. Theiss, Durham, N. C., speaker: J. C. Reed, Lewisburg, Pa., vice-speaker; R. P. Hahn, Kansas City, Mo., secretary; and A. C. Pasini, Detroit, Mich., agenda chairman.

Speakers at Luncheons and Dinners

The program of technical sessions of the Chicago Section opened on Monday with a luncheon at which D. R. Shoults, vice-president, Bell Aircraft Corporation, Buffalo, N. Y., delivered an address, "Airplanes of the Future and the Future of the Airplane." At the informal dinner on Monday evening W. J. King, member A.S.M.E., Battelle Memorial Institute, Columbus, Ohio, who has been given the 1945 Melville Prize Medal for Original Work for his paper, "The Unwritten Laws of Engineering," which appeared in MECHANICAL ENGINEERING in May, June, and July, 1944, spoke on "Personal and Personnel Problems of Engineers." New officers of the Chicago Section were introduced. F. H. Lane, chairman of the Chicago Section, presided.

At the luncheon on Tuesday A. G. Bryant, vice-president, Cleereman Machine Tool Company, Chicago, Ill., gave a talk on "Disposal of Surplus Machine Tools."

The Annual Dinner of the Chicago Section on Tuesday completed the program. The speakers were Alex D. Bailey, president of the Society, and Dr. Robert E. Wilson, chairman of the board of directors, Standard Oil Company of Indiana, whose subject was "America's Future Oil Supplies." Entertainment and dancing followed the dinner.

Shoults Speaks on Future of Airplanes

The future of the engine-driven aircraft, said D. R. Shoults at the opening luncheon, was apparently limited and could not be expected to go much beyond the present accomplishments. Compressibility of air, that is, the point at which the air no longer flows smoothly over the contour of the plane but is compressed and builds up ahead of the projected area of the plane and propeller blades, was the limiting factor in plane speeds.

Mr. Shoults, in discussing the jet propulsion of aircraft, emphasized the fact that it was not the reaction of the emerging jet on the surrounding atmosphere that produced the necessary forward thrust, but rather the unbalanced pressure within the engine itself. As a result the jet-propelled aircraft had a distinct advantage over the propeller-driven type and could be used under extremely rarified atmospheric conditions, he declared.

Going to the other extreme, the helicopter, he said, would fill a definite place in future aircraft service. The ability of the helicopter to ascend or descend vertically and even to remain stationary at a point above the surface of the earth, as accomplished in its recent development, opened up a wide field of usefulness for this type of ship.

Mr. Shoults did not feel, however, that the time had arrived or would arrive in the immediate postwar future when the helicopter would replace the automobile. In his opinion developments would be toward larger and more luxurious air liners. Moving pictures were used to illustrate Mr. Shoults's talk.

W. J. KING, BATTELLE MEMORIAL INSTITUTE, SPEAKER, AT THE MONDAY EVENING DINNER, ON "PERSONAL AND PERSONNEL PROBLEMS OF ENGINEERS"

King Speaks on Personal Problems of Engineers

At the dinner on Monday evening, W. J. King gave an interesting talk on the relationship between management and the young engineer. He expressed the opinion that much of the misunderstanding and dissatisfaction that was found in industry could be eliminated by a better realization of the conditions that must be met by each group.

All of the factors included in an ideal relationship between management and the engineer were listed, but, with a touch of humor, Mr. King pointed out that a condition covering all of these points would be ultraidealistic and probably would never be attained.

Emphasis was placed on the necessity for developing a sense of responsibility and company interest on the part of the young engineer and on his opportunity to grow in an organization. Equal emphasis was placed on the loyalty expected of the engineering staff and the willingness of the engineer to accept responsibility when offered him.

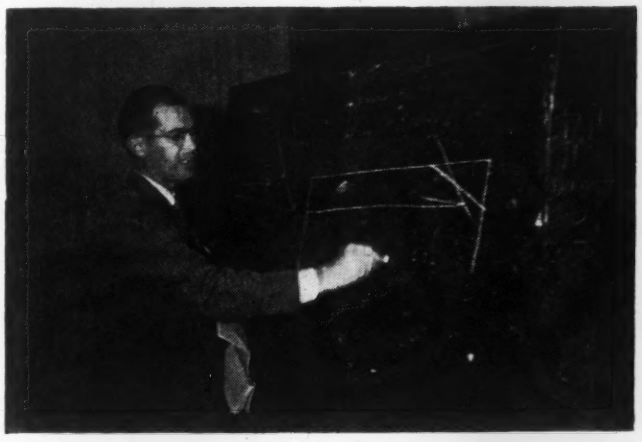
An active personnel department with a real understanding of the relationship between management and the personnel of the engineering department was necessary, Mr. King said, if satisfactory conditions were to exist. He declared that it was not the real importance of a point but the acceptance of that point in the individual's mind that must be considered. Causes for discontent, such as an untidy washroom as compared to an attractive washroom in some other plant, were given as examples of the magnified importance of small things to the individual.

Chicago Section Takes Part in Technical Program

The Chicago Section meeting, which replaced the technical program of the Semi-Annual Meeting of The American Society of Mechanical Engineers, provided an audience for a number of highly interesting technical papers. These papers were read at a series of sessions beginning Monday afternoon and continuing through Tuesday.

Tribute to F. W. Taylor

The Management Session held Monday afternoon was a tribute to Frederick W. Tay-



W. W. GILBERT, ASSOCIATE PROFESSOR, DEPARTMENT OF METAL PROCESSING, UNIVERSITY OF MICHIGAN, AT THE FIRST SSESION ON METAL CUTTING

A GROUP OF MEMBERS OF THE A.S.M.E. RESEARCH COMMITTEES ON METAL CUTTING DATA AND CUTTING FLUIDS

A. G. BRYANT (LEFT), VICE-PRESIDENT, CLEEREMAN MACHINE TOOL COMPANY AND C. B. COLE, PRESIDENT, TOOL EQUIPMENT AND SALES COMPANY

HANS ERNST, LEFT, DIRECTOR OF RESEARCH, CINCINNATI MILLING MACHINE COMPANY, AND FRED W. LUCHT, DEVELOPMENT ENGINEER, CARBOLOY COMPANY

lor, the originator of the Taylor system of metal-cutting control. W. R. Williamson told in considerable detail the origin of Taylor's time-study system and its development. A model of the tool used in many of the earlier investigations was on display as well as a number of the specialized slide rules devised by Taylor and his associates. The formulas derived during the development period were entirely too cumbersome for general use and the slide rule and nomograph were the logical results.

O. W. Boston followed and in his paper brought out the effect of Taylor's experiments on present-day practice in industry. Much of the research work now being carried out in the art of cutting metal stems from these experiments. The results of the intensive time study of operations were equally intensive studies of all other factors entering into machine operation.

Jet Propulsion and Gas Turbines

The paper prepared by Charles D. Flagle and Frank W. Godsey drew some interesting comparisons between planes driven by jet propulsion, turbine-driven propellers, and reciprocating-engine-driven propellers. The field of greatest usefulness for each was pointed out and the factors limiting these fields explained.

The gas-turbine propeller airplane was superior to the conventional aircraft in every way except in altitude ceiling, said the authors. At high altitudes they were about equal if the conventional engine was turbo-supercharged. The jet-propelled aircraft, because of its lightweight power plant, could carry a heavier load and get off the ground more readily than one using either the conventional engine or the gas turbine. Jet propulsion required more fuel than other types and hence was confined to a range under 2000 miles, they said.

Metal Cutting

Investigation had shown that the power consumed in curling the chip as it comes off the workpiece was in proportion to the heat developed in the chip, according to a paper prepared by A. O. Schmidt, O. W. Boston, and W. W. Gilbert which described research investigations carried out at the Kearney and Trecker plant and at the University of Michigan to evaluate this heat. In the tests reported, the chips dropped from the tool immediately into a measured body of water. The rise in temperature of the water and the weight of the chips could then be evaluated. The effect of tool conditions as the work of milling progressed was determined as reflected by the heat of the chips.

Radial Rake Angles

The effect of radial rake angles on face milling was covered in the paper prepared by J. B. Armitage and A. O. Schmidt. The successful application of carbide-tipped cutters depended on a number of variables, the radial rake being of prime importance when face milling, they declared. The paper brought out the variety of results obtained by a slight change in the angle.

Test Code for Greases

The paper presented by H. A. McConville emphasized the necessity for establishing a test code for greases used in ball and roller bearings. Emphasis was placed on the fact that while 95 per cent of motors were run under conditions that made the ordinary grades of greases satisfactory it was the 5 per cent run under unusual conditions that should be given greatest attention and for which greases should be developed.

Precision Lathe Spindles

The accuracy of a lathe is generally determined by the accuracy of the work produced. G. M. Foley pointed out in his paper, "New Tests for Precision Lathe Spindles," that the increasing demand for precision production made it necessary to develop an instrument capable of testing the accuracy of the lathe

spindle within very close limits. He described an electric micrometer by which measurements can be made without making contact with the piece under examination. The frequency of the instrument, which is similar to a miniature radio station, is varied by changes in the position of the spindle being examined. The inaccuracies are magnified as much as 10,000 times.

Tank Turrets

Stanley J. Mikina pointed out that the electric drive for tank turrets had been perfected just prior to "Pearl Harbor" and that this was a factor in getting these turrets into production in record time. The electric drive made it possible to turn the turret through its entire arc of travel with the same ease as would be required for a light rifle, he declared.

Design of Cantilever Beams

The paper on the design of beams by I. Opatowski brought out a method for the design of cantilever beams of uniform strength in bending. The method was to be used in cases in which the weight of the beam cannot be neglected, he said. An application for this method was found in the design for concrete structures where the span was large and the strength of the material relatively low.

Metal Cutting in Slow Motion

Lieut. Col. E. G. Moffat and M. F. Judkins presented a paper on hypermilling illustrated by a slow-motion film. The exact action of negative-rake carbide-tipped milling cutters while in contact with the workpiece was shown. The film demonstrated the importance of suiting the rake and speed to the material cut. The film reduced the cutting speed to the point at which every phase of the cutting action could be watched.

High-Speed Cutting

The paper by A. Wm. Meyer on high speed of steel confirmed many of the suggestions on which the practical application of carbide tips to milling cutters is based. Based on extensive research, the facts brought out in this paper should be of material benefit to industry.

Milling Cast Iron

The paper, "Milling Cast Iron With Carbides," presented by Michael Field and W. E. Bullack covered research on three grades of cast ferrous alloys and a variation in tool position, speeds, and feeds. Definite results were reported. In addition to test results a complete breakdown of casts was made by which the results of using carbide-tipped cutters could be compared to those found when high-speed steel cutters were used.

Thanks to the Committee

As always at all meetings there is the general committee to thank for the success of its smooth running. In this case the Committee was headed by J. D. Cunningham who was honorary chairman, J. R. Michel, active chairman, R. H. Bacon, chairman of arrangements, F. H. Lane, chairman of the Chicago Section, and J. C. Marshall, program chairman. Mr. Marshall has since been elected chairman of the Chicago Section when Mr. Lane's term ended on July 1.

Photographs

For the photographs taken at the meeting we are indebted to Mr. Ben C. Brosheer, associate editor of *American Machinist*, who supplied us with prints.

Actions of 1945 A.S.M.E. Semi-Annual Business Meeting at Chicago, Ill., June 18, 1945

THE 1945 Semi-Annual Business Meeting of The American Society of Mechanical Engineers was held at the Stevens Hotel, June 18, 1945. President Alex D. Bailey presided.

Owing to travel restrictions members of the Society had been given an opportunity to vote by proxy and the President appointed D. W. R. Morgan, H. V. Coes, and A. C. Chick to canvass the proxies.

C. E. Davies, secretary, reported results of the ballot on changes in the constitution, H. A. Carlson, J. N. Landis, and L. N. Rowley, Jr., tellers. Results of the balloting showed that four of the five changes had passed and the fifth, proposing a new grade of member, had failed to pass. The changes related to the composition of the Council and authority to make the necessary changes to put the new scheme into effect, qualifications for the member grade, substitution of "section" for "local section," and the dropping of the hyphen in "Student Member."

The Secretary also reported favorable balloting of members on the Society's pension plan.

The Secretary announced that the 1946 Semi-Annual Meeting would be held in Detroit, Mich., at a time during the summer to be selected by the Council.

1946 Nominating Committee

Colonel Davies announced that, in view of the fact that this year the group conferences of sections had been held in the spring instead of the fall, the 1946 Nominating Committee had been nominated.

J. A. Keeth, chairman of the Committee on Sections, presented the following list of members of the 194. Nominating Committee, all of whom were unanimously elected:

GROUP I: J. W. Zeller, Northeastern University, 360 Huntington Ave., Boston, Mass.; W. K. Simpson, first alternate, 9 Sands St., Waterbury 30, Conn.; L. J. Hooper, second alternate, Highland Ave., Holden, Mass.

GROUP II: H. E. Martin, Babcock & Wilcox Company, 85 Liberty St., New York N. Y.; J. H. Sengstaken, first alternate, Western Precipitation Corporation, 405 Lexington Ave., New York, N. Y.; A. Ehbrecht, second alternate, Gries Reproducer Corporation, 780 East 133rd St., New York, N. Y.

GROUP III: A. R. Smith, General Electric Company, Schenectady, N. Y.; C. E. Miller, first alternate, Office of Chief Engineer, 21st and Virginia Ave., Washington, D. C.; R. C. Dannettel, second alternate, Consolidated Gas Electric Light and Power Company, Baltimore, Md.; W. H. Chaffee, third alternate, 801 St. Marks Ave., Westfield, N. J.

GROUP IV: P. R. Yopp, 3509 Piedmont Road, Atlanta, Ga.; Neil H. Brown, first alternate, 1117 Liberty Life Building, Charlotte 2, N. C.; J. B. Jones, second alternate, Virginia Polytechnic Institute, Box 205, Blacksburg 3, Va.; H. G. Mouat, third alternate, Whiting Corporation, 544 Martin Building, Birmingham, Ala.

GROUP V: E. J. Martin, Procter and Gamble Company, Ivorydale, Ohio; F. H. Vose, first alternate, Case School of Applied Science, 10900 Euclid Ave., Cleveland, Ohio; W. D. Sheldon, Jr., second alternate, Sheldon Ltd., Galt, Ont., Can.

GROUP VI: W. W. Babcock, Central Illinois Light Company, Peoria, Ill.; H. O. Croft, first alternate, University of Iowa, 122 Engineering Building, Iowa City, Iowa; F. P. Shannon, second alternate, Henry Vogt Machine Company, 10th and Armsby St., Louisville, Ky.

GROUP VII: Ralph L. Dyer, Insurance Building, Seattle, Wash.; Fairman B. Lee, 117 Garfield St., Seattle, Wash.

GROUP VIII: H. R. Hughes, Jr., W.R.C. Smith Publishing Company, 1341 Liberty Bank Building, Dallas 1, Tex.; L. J. Cucullu, first alternate, New Orleans Public Service, Inc., 317 Baronne St., New Orleans, La.; O. L. Lewis, second alternate, Jones and Laughlin Supply Company, 108 N. Trenton, Tulsa, Okla.

A.S.M.E. 1946 Nominating Committee Organizes

SELECTED at the 1945 Semi-Annual-Business Meeting of The American Society of Mechanical Engineers, Chicago, Ill., June 18, 1945, the 1946 Nominating Committee, at its organization meeting, chose H. E. Martin, The Babcock and Wilcox Company, 85 Liberty St., New York, N. Y., as chairman, and W. W. Babcock, Central Illinois Light Company, Peoria, Ill., as secretary.

Arrangements were made for a preliminary meeting of the committee in February and for the executive meeting, at which nominations of Society officers will be made, in Detroit, during the 1946 Semi-Annual Meeting of the Society, to be scheduled some time in June, 1946.

A complete list of the members of the 1946 Nominating Committee will be found in the report of the 1945 Semi-Annual Business Meeting on this page.

L. E. Seeley to Be Dean of New Hampshire

APPOINTMENT of Lauren Earl Seeley, member A.S.M.E., associate professor of mechanical engineering at the Yale School of Engineering, to be dean of the college of technology at the University of New Hampshire, Durham, N. H., has been announced.

Professor Seeley has contributed several papers to MECHANICAL ENGINEERING.

Actions of the A.S.M.E. Council

At Meeting Held at Hotel Stevens Chicago, Ill., June 17–18, 1945

THE Council of The American Society of Mechanical Engineers met at the Stevens Hotel, Chicago, Ill., June 17 and 18. There were sessions on both days, and present at one or more of these sessions were: Alex D. Bailey, president, who presided, Harold V. Coes and William A. Hanley, past-presidents; David Larkin, Thomas S. McEwan, D. W. R. Morgan, Jonathan A. Noyes, and Ford L. Wilkinson, Jr., vice-presidents; Alton C. Chick, Arthur J. Kerr, Roscoe W. Morton, James M. Robert, A. R. Stevenson, Jr., and Albert E. White, managers; L. E. Jermy, J. A. Keeth, and O. B. Lyman (Sections); W. H. Hill (Standardization), F. G. Switzer (Meetings and Program), G. L. Knight (Finance, Pension, Society Organization Structure), R. L. Parsell (Constitution and By-Laws); R. W. Flynn, R. P. Hahn, K. R. Hodges, M. B. Hogan, O. L. Lewis, J. C. Marshall, A. C. Pasini, J. H. Potter, R. G. Roshong, J. C. Reed, W. P. Saunier, E. S. Theiss, J. J. Uicker, Herman Weisberg, and E. E. Williams (Delegates Group Conference); W. W. Babcock, F. W. Candee, J. B. Jones, Hunter R. Hughes, Jr., W. H. Larkin, H. E. Martin, H. L. Mason, C. F. Moulton, R. A. Sherman, M. C. Stuart, and P. R. Yopp (Nominating Committee); F. D. Cotterman, Harry S. Nachman, and J. D. Pierce (Junior observers); C. E. Davies, secretary; Ernest Hartford, executive Assistant Secretary; and R. B. Smith, A.S.M.E. staff.

Honors and Awards

Upon recommendation of the Board of Honors and Awards, the Council voted to approve the following awards for 1945:

A.S.M.E. MEDAL, to William Frederick Durand.

HOLLEY MEDAL, to Sanford A. Moss, "for his many contributions over a long period of years to the development of centrifugal compressors, particularly as related to the highly successful application of turbosuperchargers to internal-combustion engines in the field of aeronautics."

WORCESTER REED WARNER MEDAL, to Joseph M. Juran, "for his outstanding contribution to the problem of quality control in mass-production and his splendid records of such work as are contained in his books, 'Bureaucracy, A Challenge to Better Management' and 'Organization and Management of Quality Control.'"

MELVILLE PRIZE MEDAL FOR ORIGINAL WORK, to William Julian King, "for his paper 'The Unwritten Laws of Engineering.'"

JUNIOR AWARD, to Bruce D. Del Mar, "for his paper, 'Presentation of Centrifugal Compressor Performance in Terms of Non-dimensional Relationships.'"

Visits to Sections and Branches

Members of the Council reported on their visits since the 1945 Annual Meeting to the sections and student branches. Attention was called to the attendance at the lectures by Dr. Marks and Dr. Gilbreth.

1946 Semi-Annual Meeting

Approval was voted of holding the 1946 Semi-Annual Meeting at Detroit, Mich., at some date to be announced later.

International Relations

A statement of purposes and objectives of the Committee on International Relations was approved.

Latin-American Societies

Dean S. S. Steinberg, College of Engineering, University of Maryland, was designated official representative of A.S.M.E. to engineering societies during the visit to Latin-American countries which he is to make at the request of the United States Department of State.

Group Delegates Conference

The Group Delegates Conference, usually held in New York during the A.S.M.E. Annual Meeting, was held in Chicago, Ill., June 16–17, 1945. J. J. Uicker, speaker for the 1945 Group Delegates Conference, summarized the actions and recommendations of the Conference, and the Council instructed the Secretary to transmit the recommendations to the committees concerned for action and report to the Council. Appreciation and thanks were expressed to the delegates for their services.

Budget for 1945-1946

The statement of policies and estimate of income and the budget expenditures for 1945–46 was approved. [The 1945–1946

ESTIMATED INCOME FOR 1945–1946 ADOPTED BY THE COUNCIL OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, JUNE, 1945

Income	Actual 1943–1944	Budget 1944–1945	Estimate 1945–1946
Initiation and Promotion Fees (to Surplus)	$ 19,655.00	$ 15,000.00	$ 15,000.00
Membership dues	257,597.53	250,000.00	245,000.00
Student dues	12,279.00	5,000.00	8,000.00
Interest and discount	8,153.58	4,000.00	5,000.00
MECHANICAL ENGINEERING, advertising	242,488.31	250,000.00	225,000.00
Mechanical Catalog, advertising	82,832.74	75,000.00	75,000.00
Publications sales	104,254.98	75,000.00	75,000.00
Engineering Index, Inc	1,356.60	1,600.00	1,200.00
Registration fees	1,113.00	750.00	300.00
Sale of equipment	75.00	700.00	.....
Membership List advertising	1,029.00	.....	.....
Miscellaneous sales	2,491.02	2,000.00	2,500.00
Total Income	$713,670.76	$664,050.00	$637,000.00
To be added to surplus	86,272.94	10,275.00	12,253.00
Balance for Expense	$627,397.82	$653,775.00	$624.747.00

ESTIMATED BUDGET FOR 1945–1946 ADOPTED BY THE COUNCIL OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, JUNE, 1945

Activity	Expense under committee supervision	Printing and distribution	Direct office expense	Total
Council	$ 5,750.00	.....	.....	$ 5,750.00
Library	10,386.00	.....	.....	10,386.00
E.C.P.D.	1,200.00	.....	.....	1,200.00
Awards	720.00	.....	$ 468.00	1,188.00
Nominating Committee	2,375.00	.....	.....	2,375.00
Sections	34,000.00	.....	11,217.00	45,217.00
Meetings and Program	18,000.00	.....	11,713.00	29,713.00
Professional Divisions	3,700.00	.....	10,812.00	14,512.00
Admissions	.....	.....	11,121.00	11,121.00
Employment Reserve	2,000.00	.....	.....	2,000.00
Student Branches	6,000.00	$ 2,000.00	5,789.00	13,789.00
Technical Committees	1,000.00	.....	25,407.00	26,407.00
MECHANICAL ENGINEERING, text pages	.....	29,000.00	12,457.00	41,457.00
Transactions and *Journal of Applied Mechanics*	200.00	38,200.00	14,796.00	53,196.00
Membership List	.....	7,000.00	1,300.00	8,300.00
MECHANICAL ENGINEERING, advertising pages	.....	45,100.00	51,058.00	96,158.00
A.S.M.E. Mechanical Catalog	.....	30,000.00	35,945.00	65,945.00
Publications Sales	.....	32,500.00	14,889.00	47,389.00
Retirement Fund	21,700.00	.....	.....	21,700.00
Professional services	2,100.00	.....	.....	2,100.00
Membership Development	2,500.00	.....	350.00	2,850.00
Aviation	.....	.....	4,000.00	4,000.00
Organization charts	500.00	.....	.....	500.00
Secretary's office	.....	.....	19,540.00	19,540.00
Accounting	.....	.....	24,352.00	24,352.00
General service	.....	.....	45,113.00	45,113.00
General office	.....	.....	28,489.00	28,489.00
	$112,131.00	$183,800.00	$328,816.00	$624.747.00

budget will be found on page 543 of this issue. —Editor.]

Honorary Members

The following were elected Honorary Members of The American Society of Mechanical Engineers:

Rear Admiral Harold Gardiner Bowen, U.S.N., Naval Research Laboratory, Anacostia Station, Washington, D. C.

Dugald Caleb Jackson, Cambridge, Mass.

Andrey Abraham Potter, West Lafayette, Ind.

Sir William Stanier, The London, Midland and Scottish Railway, The Grove, Watford, Herts, England.

Dr. Wong, Wen-hao, vice-president of the Executive Yguan, Ministry of Economic Affairs, Chungking, China.

Council Member Appointed

Edward E. Williams, of Charlotte, N. C., was appointed manager of the Society to serve, until Nov. 30, 1945, the unexpired term of H. G. Thielscher, resigned.

Actions of A.S.M.E. Executive Committee

At Meeting Held at Stevens Hotel, Chicago, Ill., June 17, 1945

A MEETING of the Executive Committee of the Council of The American Society of Mechanical Engineers met at the Stevens Hotel, Chicago, Ill., on June 17, 1945. There were present: Alex D. Bailey, chairman, Alton C. Chick, A. R. Stevenson, Jr., and D. W. R. Morgan, of the Committee; Harold V. Coes, David Larkin, Roscoe W. Morton, J. A. Noyes, James M. Robert, and F. L. Wilkinson, Jr., members of the Council; G. L. Knight (Finance and Pension), J. A. Keeth (Sections), and F. G. Switzer (Meetings and Program); and C. E. Davies, secretary.

The following actions were of general interest.

Pensions

Mr. Knight presented some matters relating to the pension plan and submitted the draft of a descriptive brochure, to be issued to the employees, which the Committee reviewed.

1946 Semi-Annual Meeting

Upon the joint recommendation of the committees on Sections and Meetings and Program, it was voted to recommend to the Council that Detroit, Mich., be selected for the 1946 Semi-Annual Meeting of the Society, at a date to be determined later.

Properties of Gases

Authorization was voted of the establishment of a Special Committee on Properties of Gases and Gas Mixtures.

Power Test Codes

Approval was voted of the adoption of the revision of the Code on General Instructions (Power Test Codes Committee) as a standard practice of the Society.

The question of quantity sale to students of the Code on General Instructions was referred to the Secretary with the understanding that the special price to be set would cover the cost of the code and distribution.

Approval was voted of the adoption of the revision of the Code on Definitions and Values as standard practice of the Society.

Safety

Adoption was voted, as a standard of the Society, and for transmission to the American Standards Association for approval as an American Standard, of the proposed revision of the American Standard Recommended Practice for the Inspection of Elevators, Inspectors' Manual.

Returned Veterans Conference

An invitation of the American Society of Civil Engineers to be represented at the Washington Conference, June 25–26, for the purpose of exploring the possibilities of aiding the returned veteran, was accepted, and A. M. Gompf, consulting engineer, Egli and Gompf, Baltimore, Md., was appointed to represent the Society at the conference.

Institution of Mechanical Engineers

It was reported that two members of A.S.M.E., Jerome C. Hunsaker and E. G. Bailey, had been elected honorary members of The Institution of Mechanical Engineers.

In view of the fact that Ronald R. Allwork, executive officer, Combined Production and Resources' Board, W.P.B., was planning to visit England in order to facilitate the work of the coming Conference, in which A.S.M.E. is participating, to be held in Canada, on a comprehensive project to develop international standards on screw threads, cylindrical fits, and design and drafting practice, it was voted to approve greetings for transmission to the members of The Institution of Mechanical Engineers and other engineering societies in the United Kingdom through Mr. Allwork.

Chinese Engineers

The Secretary presented a communication from Paul B. Eaton, dated June 15, 1945, to the effect that at the Georgetown University, Washington, D. C., an orientation program is being run for approximately 1000 engineers from China who will be in this country for one year of intensive training. These men are mature, engineering university graduates in China who have had an average of about ten years of practical experience. They are to be oriented for approximately a month before they enter industry for training, the orientation to consist of securing essential reference books and guided reading and instruction in the specific training field they are about to enter.

Mr. Eaton wrote that aid was needed for placement of certain Chinese engineers and that the Council of the Society might be able to assist. This was referred to the Committee on International Relations.

Death of George T. Seabury

The Committee noted with regret the death, on May 25, 1945, of George T. Seabury, secretary of the American Society of Civil Engineers. Roy V. Wright had been designated honorary vice-president to represent the Society at the funeral and a floral tribute had been sent on behalf of members of the Council.

Research Board for National Security

On May 24 the Executive Committee of the Council voted to approve Senate Bill S 825 establishing a Research Board for National Security, subject to legal review of the bill (MECHANICAL ENGINEERING, July, 1945, page 484).

The Secretary reported that, acting under instructions, he had discussed the subject with F. B. Jewett, president of the National Academy of Sciences, and had learned that the Academy would not support the bill as it did not seem wise to set up an independent agency.

Another bill, pending, would have the support of the Academy and hence the Committee voted to rescind its action of May 24 in approving Senate Bill S 825.

Appointments

The following appointments were approved:

Special Committee on Critical Pressure Steam Boilers, W. H. Rowand.

Power Test Codes Committee No. 20 on Speed, Temperature, and Pressure Responsive Governors, M. J. Steinberg and P. G. Ipsen.

Washington Award Commission, John R. Michel (two-year term).

National Research Council Division of Engineering and Industrial Research, A. E. White.

Electrical Engineers Elect Officers

WILLIAM E. WICKENDEN, member A.S.M.E., president, Case School of Applied Science, Cleveland, Ohio, was elected president of the American Institute of Electrical Engineers for the year beginning August 1, 1945, as announced at the annual meeting of the Institute held in New York, N. Y., June 27.

The other officers elected were: Vice-Presidents, E. S. Fields, Cincinnati, Ohio; H. B. Wolf, Charlotte, N. C.; L. M. Robertson, Denver, Colo.; F. F. Evenson, San Diego, Calif.; F. L. Lawton, Montreal, Canada; Directors J. M. Flanigen, Atlanta, Ga.; J. R. North, Jackson, Mich.; Walter C. Smith, San Francisco, Calif.; National Treasurer, W. I. Slichter, fellow A.S.M.E., New York, N. Y. (Re-elected)

These officers, together with the following holdover officers, will constitute the Board of Directors for the next administrative year, beginning August 1, 1945: Charles A. Powel, member A.S.M.E., East Pittsburgh, Pa. (retiring president); Nevin E. Funk, fellow A.S.M.E., Philadelphia, Pa. (junior past-president); P. L. Alger, member A.S.M.E., Schenectady, N. Y.; C. B. Carpenter, Portland, Ore.; M. S. Coover, Ames, Iowa; J. F. Fairman, New York, N. Y.; K. L. Hansen, Milwaukee, Wis.; R. T. Henry, Buffalo, N. Y.; C. M. Laffoon, East Pittsburgh, Pa.; M. J. McHenry, Toronto, Canada; C. W. Mier, Dallas, Tex.; S. H. Mortensen, Milwaukee, Wis.; W. B. Morton, Philadelphia, Pa.; D. A. Quarles, New York, N. Y.; W. R. Smith, Newark, N. J.; R. W. Warner, Austin, Texas.

President's Page

Society Membership

DURING the recent widespread discussion about qualifications for membership there has been general agreement that membership requirements should not be lowered. This has been discussed at meetings of the Executive Committee and of Council, and at the annual business meeting last winter where this subject was discussed by the membership, the only change made was one regarding the age qualification for members, and this received the overwhelming approval of the membership.

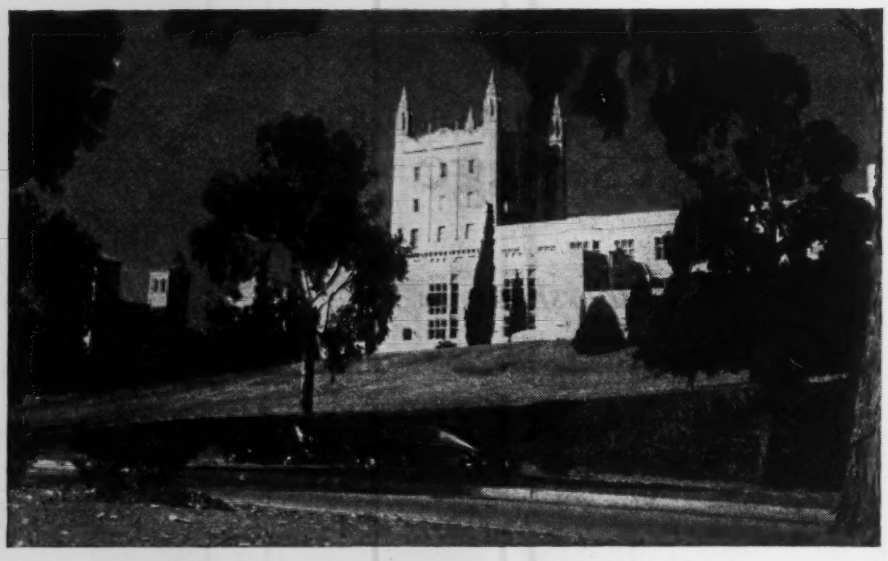
The fact remains, however, that there are many qualified and able mechanical engineers who are not members of our Society—men who for one reason or another have not been sold on the importance of being a member of the Society which represents their profession and the advantages of taking an active part in its proceedings. The Society represents them indirectly even though they are not members. Their lack of interest may be due to the fact that they do not realize how much they need the Society and how much the Society needs them.

It is satisfying to know that nearly one quarter of our members are taking active part in some branch of our Society's activities. It is fine evidence of their interest in the organization and loyalty to their profession. All the other members are to be commended as well for the support they are giving the Society and their profession by membership in the Society. Many have been active in past years while others have not made their ability known or have not felt that they could afford to give the time due to other pressing duties. Our membership is truly a working membership.

The importance and strength of a society depends not only on the quality of its members, but also on its numerical strength if it is to have prestige and usefulness as an organization and corresponding ability to serve. This is a day of large organizations, industrially and politically, and if engineers expect to receive proper recognition they must perfect the organization of the society which represents them so that its membership will be representative and properly represented.

The Committee on Membership Development, with a nationwide personnel, is starting a campaign to extend the usefulness of our Society to those mechanical engineers who thus far have not enjoyed the many benefits its membership offers and whose support it merits. This is a job in which all members can participate and one which deserves their unqualified support.

(*Signed*) Alex D. Bailey, *President*, A.S.M.E.



CAMPUS OF UNIVERSITY OF CALIFORNIA AT LOS ANGELES, WHERE A.S.M.E. LOS ANGELES AVIATION WAR CONFERENCE WAS HELD. ROYCE HALL AT EXTREME LEFT, WHERE OPENING SESSION WAS HELD. KERCKOFF HALL, STUDENTS' AND FACULTY CLUBS ARE IN FOREGROUND

Large Attendance Features A.S.M.E. Aviation War Conference Held at Los Angeles, June 11–14, 1945

THE A.S.M.E. Aviation Division, in cooperation with the Southern California Section of The American Society of Mechanical Engineers and the University of California at Los Angeles, celebrated the 25th anniversary of the Division with an outstandingly successful meeting, June 11–14, 1945. The total attendance at the fifteen sessions was 2200.

The meeting was held on the campus of the University of California at Los Angeles, and all sessions were in the evenings.

The general chairman of the meeting, Timothy E. Colvin, and the chairman of the Southern California Section, Ray G. Roshong, shared honors for the general success of the meeting.

The excellent programs for the sessions, representing heat transfer, rubber and plastics, production, applied mechanics, metals engineering, instruments and regulators, management, and oil and gas power, were arranged by the program committee of twenty members under the chairmanship of T. A. Watson. The untimely death of Tom Watson, a few days before the meeting, however, cast a gloom over his many friends and co-workers. While his name still appeared on the programs, his broad smile and friendly hand shakes were gone forever. The A.S.M.E. has lost a grand member.

The perfectly smooth, and efficient operation of the sessions was the result of the careful planning and the industry of the committee on arrangements with Prof. W. E. Mason as chairman, and Dean L. M. K. Boelter and Wesley L. Orr as members, assisted by Dr. Clifford Bell and John C. Dillon.

As usual, the University of California staff worked untiringly for the success of the meeting. All agreed that the University was an ideal place for such meetings and are looking forward to a similar meeting next June.

Gas Turbines and Jet Propulsion

The first session on gas turbines and jet propulsion, the only one scheduled for Monday evening, June 11, was held in the beautiful Royce Hall Auditorium. The attendance was approximately twelve hundred. The session was presided over by Dean L. M. K. Boelter dean of the new engineering school at U.C.L.A., assisted by J. C. Dillon and Wesley L. Orr.

The engineers were welcomed by Dr. Clarence A. Dykstra, provost, University of California at Los Angeles. He spoke of the great tasks for engineers which lie ahead in the postwar period when all the wartime technological developments must be adapted to peacetime uses.

"Technological advances during the war have been stupendous," said Dr. Dykstra. "The imagination is spurred to new action when we consider the peacetime potential of such developments as propulsion by jet, rocket, and gas turbine; radar; the laminar wing; synthetic fuels, rubber and textiles; new materials for construction; and improved production techniques.

"The universities, industry, and the community must all work together to utilize these advances for the common good. The burden placed upon the engineer is great. He must translate these technical data and experiences into peacetime economic enterprises and goods. In so doing he may help, at least to a degree, to compensate for the tremendous material damage done by war."

Among contributions which education stands ready to make to this task, Dr. Dykstra mentioned the new research made possible by the giant wind tunnel at the California Institute of Technology and the new program of instruction and research to follow the inauguration of the College of Engineering, emphasizing aeronautics, at the University of California, Los Angeles.

Dr. M. J. Zucrow, executive engineer, Aerojet Engineering Corporation, Azusa, Calif., in his paper, "Jet Propulsion and Rockets for Assisted Take-Off," discussed the thermal jet engine and the rocket motor, holding that the latter form thus far has its principal usefulness in the field of assisted take-offs. He pointed out that at present, because of its high fuel consumption, the application of the thermal jet engine appears to be restricted to short-endurance military craft. Until more of the operating data and actual performance characteristics of aircraft equipped with this form of power plant become available, the possibilities of applying thermal jet propulsion to civilian aircraft cannot be expressed with certainty.

A great deal of attention has been given to the apparent limitations of this method of propulsion, particularly to its high fuel consumption. But these limitations appear to be related, to some extent at least, to the present state of the developments in the field of aerodynamics. Since thermal jet propulsion imposes less design restriction upon the airplane designer, the commercial future of thermal jet propulsion is greatly dependent on the ability of airplane designers to produce lower-drag airplanes.

Perhaps the most attractive feature of the thermal jet engine, apart from its ability to provide propulsion at high speeds, is its simplicity and low weight. Furthermore, this power plant is relatively free from vibration, permits using cheaper fuels than high-octane gasoline, and should require less frequent major overhauls.

Many problems are presented by the high operating temperatures required to obtain even fair fuel economy. Since weight and space are major considerations, the rate of heat liberation per cubic foot of combustion chamber has to be extremely high. For it to have reasonable life, its design must be arranged to give clean and reliable combustion and the walls must be kept at safe operating temperatures.

There are still metallurgical problems to be solved if higher operating temperatures are to be realized. In addition, there are problems in compensating for differences in thermal expansion. The fact that thermal jet propulsion has become a practical reality is an indication, however, that great progress has been made in solving these problems.

Rocket Motor Use Described

Regarding the rocket motor, known as the Jato unit, the speaker said: In this country the principal application of rockets to aircraft, apart from their use as weapons, is in the field of assisted take-off. Most of the applications have been to flying boats where the added thrust of the Jato units has made it possible to take off under conditions such that without them successful take-off would be problematical. This has increased the usefulness of such aircraft for rescue work in forward areas. Jato units have also been applied to carrier and land-based aircraft. As is to be expected, reductions in take-off time and distance or both have resulted from their use.

RAY G. ROSHONG, CHAIRMAN, SOUTHERN CALIFORNIA SECTION, A.S.M.E., WHO WORKED UNTIRINGLY FOR SUCCESS OF AVIATION MEETING

Two types of unit have been applied, those employing liquid propellants and those employing a solid propellant. To the writer's knowledge, the solid propellant units have found the greatest favor, owing to the ease of their installation and the fewer logistic problems introduced by their use.

Liquid-propellant Jato units have been constructed so that they can be mounted either as fixed installations in the aircraft or so they can be dropped by parachute after use. Reliable liquid-propellant rocket motors have been developed that have been operated without difficulty for continuous periods of several minutes at a time. These motors are light in weight and are cooled by circulating one of the propellants around the combustion chamber and nozzle.

For example, a rocket motor of this type developing 1500 to 2000 lb thrust can be built to weigh less than 45 lb. In such a motor the heat release will be of the order of 50,000,000 Btu per cu ft per hr, as contrasted with stationary-boiler practice where the rate of heat liberation is less than 500,000 Btu per cu ft per hr. For security reasons, the design details of this type of motor cannot be released, nor can information be presented regarding the developments concerned with propellants or pressurizing means.

Col. Homer Boushey, commanding officer of the 412th Fighter Group, Bakersfield Army Air Field, Bakersfield, Calif., speaking on "Jet Propelled Airplanes," pointed to advantages which he believes will make the jet plane important in future flying.

Jet planes will go faster, go higher, are lighter in weight for given power at speeds above 400 mph, are simpler, and under postwar mass production they should be cheaper to build than conventional planes, he said.

"There is no doubt in my mind that jet propulsion will have an important place, not only in effective military planes of the future, but also in high-speed luxury liners," Colonel Boushey said. "In the small-plane field, I have great confidence that the gas turbine driving a small propeller will find wide use. This should make a very good small airplane with little wear and practically no maintenance."

Aviation-Heat Transfer[1]

"Electrical Ignition for Aircraft Internal Combustion Heaters," was the title of a paper by E. H. Plesset, M. S. Plesset, J. D. McCrum, and T. N. Floyd, presented at the first of the aviation-heat-transfer sessions.

The speakers discussed the effects of air-fuel ratio, altitude, low temperature, and fuel atomization on ignition characteristics of combustion heaters. They brought out the relationship existing between sparking or arcing voltage, and air gap width between two electrodes, and also the power required to ignite various air-fuel mixtures. Finally, test procedures were outlined by which a satisfactory ignition system was developed.

The main point brought out in the discussion was that on the configuration tested, a small quantity of air introduced around the fuel nozzle was essential toward maintaining good combustion and clean spark electrodes.

In a paper entitled "The Influence of Tube Shape on Heat-Transfer Coefficients in Air to Air Heat Exchangers," by F. H. Green and L. S. King, three tube shapes were discussed, round, flattened, and dimpled. Tests were conducted to determine which type gave the greatest heat transfer for the amount of power consumed in pushing air through. A correlation was made between test data and previous results as given in standard heat-transfer texts. The flattened dimpled tube was found to be the most efficient generally.

Aviation-Production

Speakers at the first session on aviation production, devoted to standards and quality control, were John Howell, standards analyst of Northrop Aircraft, Inc., Hawthorne, Calif.; Wallace Johnson, consultant of gaging and inspection problems, Douglas Aircraft Co., El Segunda, Calif.; and Milton Gray, partner of Erb and Gray Scientific Instrument Company, Los Angeles, Calif. Dr. Clifford Bell of the University of California at Los Angeles was chairman of the meeting, and Dr. Preston Hammer of Lockheed Aircraft Corporation was assistant chairman.

[1] Reported by Chairman H. S. Gordon.

Discussing the increasing willingness of aircraft tooling and fabrication departments to use optical instruments, Mr. Gray noted particularly the utility of a small-bore periscopic device borrowed from the field of medicine where it is known variously as the cystoscope, bronchioscope, and the like. Such instruments, he said, have become the means of inspecting many almost inaccessible spots around aircraft motors, hydraulic systems, control housings, and other installations having small apertures for insertion of an instrument.

Of similar use in the aircraft industry is the bore-inspection telescope originally designed to inspect the riflings and internal finish of big gun barrels, Mr. Gray said. This instrument in redesigned form becomes an important means of photographing or inspecting visually many parts of an airplane which otherwise could not be achieved without inconvenient and expensive removal of some parts of the structure.

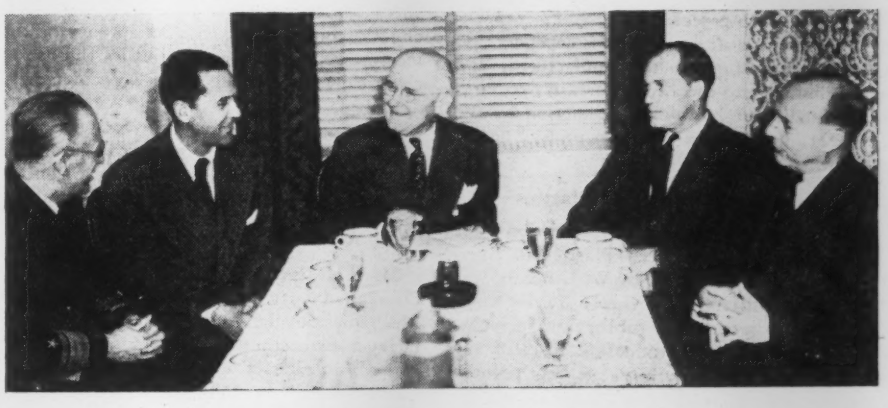
The speaker noted also use of the transit for leveling and point check-back on large jigs, and use of a telescope-collimator combination as an optical taut wire for locating a series of points in a straight line.

Statistics Also Applied

Mr. Howell emphasized the necessity and value of applying well-standardized statistical methods to quality control in aircraft manufacture. Such methods, he said, can be used in the two principal phases of the problem, process control in the plant, and quality assurance with respect to materials and parts acquired elsewhere.

Such control methods, involving the use of control charts and requiring usually only simple arithmetic, have been widely used in industry for a number of years, the speaker said. Specific applications have been made in the control of quality of machined parts, automatic packaging machinery, control of the amounts of explosive in ammunition, and control of chemical processes. In addition, he said, control can be applied in such fields as the amount of overtime worked.

"Quality does not happen, it must be planned," Mr. Howell declared. "Quality has its beginning in the design of a product. I



LUNCHEON GIVEN AT JONATHAN CLUB BY MR. COLVIN FOR MEMBERS OF THE HONORARY ADVISORY COMMITTEE OF THE A.S.M.E. AVIATION WAR CONFERENCE HELD JUNE 11–14 AT U.C.L.A.

(*Left to right:* Admiral E. M. Pace; T. E. Colvin, general chairman of A.S.M.E. Aviation War Conference; Dr. John E. Younger, executive secretary of A.S.M.E. Aviation Division; G. A. Huggins, Douglas Aircraft Company, Inc., plant manager, Douglas, Long Beach; J. Calvin Brown, member Executive Committee, Southern California Section.)

DR. M. J. ZUCROW, EXECUTIVE ENGINEER, AEROJET ENGINEERING CORPORATION, SPEAKS ON JET PROPULSION AND ROCKETS FOR ASSISTED TAKE-OFF, BEFORE AUDIENCE OF 1200 AT OPENING SESSION IN ROYCE HALL AUDITORIUM

the design is good, the chances for good quality are much better than if the design is poor. In order for design to be good, the designer must know the capabilities and limitations of equipment at hand and available.

"The knowledge is most readily obtained by quality-control records of previous product. The setting of quality standards and establishment of acceptable quality level is an engineering problem with which the statistician can lend valuable assistance."

Gage-Control System Aids Quality

Mr. Johnson stressed the importance of a rigid gage-control system for improving future quality production standards. He discussed control and application of modern visual indicator gages and comparators to production and inspection, the keeping of adequate and permanent records of gaging methods and manufacturing processes, and the benefits of such procedures.

"Future aircraft production is dependent on the quality of products manufactured, and this challenge to the aircraft industry requires that quality be built into production by the control of gages and precision tools," he declared.

Aviation-Rubber and Plastics[2]

The paper, "Design Considerations for High Strength Reinforced Plastics in Relation to Future Aircraft," by W. I. Beach, was read by J. Williamson, Glenn H. Taylor Company, at a session on rubber and plastics. The paper reviewed production costs of aircraft components generally. It was pointed out that low-pressure molding lends itself to future aircraft production, particularly in preparing sandwich constructions. Tremendous amount of weight could be saved by tapering wing thickness away from points of maximum stress. Thicker sheets are employed because of fabrication imperfections. A plastic monocoque wing was compared with a metal wing. Balsa core was limited by water absorption and trend was toward a resinous foam core. A design was proposed for a true plastic monocoque wing.

E. Marx in his paper, "Engineering Considerations for Molded Aircraft Parts," pointed out that weight savings and reliable performance are expected for aircraft molded parts. General classifications and uses of the plastics were evaluated. Numerous aircraft applications were cited and were available for inspection. Processes and fabrication methods and their influence on the design of molded parts were cited.

C. Sachs in his paper, "Cellular Plastics in Aircraft," said that cellular plastics are particularly useful in preventing compression buckling. Solvent blowing agents, solid yielding gas, or soluble gas under pressure were cited as methods of preparing thermoplastic foams. Samples ranging from 2 lb per cu ft density up were exhibited and passed around.

[2] Reported by Chairman John Delmonte.

Aviation-Instruments and Regulators[3]

The paper by J. W. Kelly, "New Developments in Combination Controls," presented at the session on instrument and regulators, covered the use of combined electrical and hydraulic circuits for aircraft control purposes. It was shown that considerable weight reductions could be obtained by the use of combined electrical and hydraulic devices for larger-capacity systems and where long lines are involved.

The paper by Sydney Westman and Edward Partington, "Electronic Recording of High Speed Pressure Transients in Fluid," reviewed the use of the oscillograph for the measurement of pressures, strains, movements, loads, and other functions which fluctuate at high frequencies and cannot be measured in any other way. The use of electrical strain gages and inductive and magnetostrictive pressure gages was thoroughly covered, and that there are excellent possibilities for the measurement of high-speed pressure transients by their use was emphasized.

The paper, "Latest Developments in Aircraft Controls and Instrumentation," by A. E. Baak and R. A. Franzel, indicated the great possibilities of temperature-sensitive resistances for the control of aircraft cabin and engine temperatures. A new system for the measurement of fuel quantities by the use of electrical-condenser type gages was completely described.

The lengthy discussions showed a great deal of interest in the use of electrical means for recording various factors and for the control and measurement of temperatures in aircraft.

Aviation-Applied Mechanics[4]

M. A. Miner, in his paper "Cumulative Damage in Fatigue," presented at the Applied Mechanics Session, stated that in cumulative fatigue of structural materials a series of tests was run in each of which several consecutive series of loads were applied at different stresses and range ratios. Good agreement was found with the formula

$$\Sigma \frac{n}{N} = 1$$

where n is the number of cycles of a particular loading applied and N is the number necessary to cause failure at that loading.

W. H. Foster and V. Seliger, in their paper, "An Empirical Approach to Fatigue Analysis of Structures," described a system for predicting fatigue life of structures. It is based on properties of materials and takes into account stress-concentration factors and their alleviation due to plastic flow.

R. W. Powell, in his paper, "A Device for Indicating Sequence of Regional Failure of Static Test Specimens," described a system for finding the point of initial failure in a test of a structure. He employs fine copper wires cemented to the structure at critical points. Each wire is in parallel with a fast-charging condenser, and the first wire to break is shown by largest condenser voltage, etc. Time differences of 500 microseconds may be detected.

[3] Reported by S. G. Eskin.

[4] Reported by Chairman C. H. Heilbron.

Aviation-Heat Transfer[5]

"The Behavior of the Hot-Wire Anemometer Subjected to Periodic Velocity," was the title of a paper by R. C. Martinelli and R. D. Randall delivered at the second heat-transfer session. It was presented by Mr. Martinelli.

A method illustrated by slides was presented which allows a rapid graphical prediction of the response of the constant-current hot-wire anemometer to a periodic velocity. From such a prediction the suitability of the hot-wire anemometer for any particular application can be readily determined. The method was illustrated by several illustrative examples. In addition it was pointed out that the differential analyzer could be used to solve more complex phases of the problem than was illustrated. The "isocline" method was described as a solution of the differential equation which leads quickly to an engineering answer.

With the paper, "Design and Construction of a Refrigerated Altitude Chamber," by C. J. Lyall, a colored motion picture of the construction of a large refrigerated altitude chamber was shown. The purpose of the chamber was to simulate flight on the ground. Altitudes could be varied from sea level to 60,000 ft at the rate of 7500 fpm maintaining NACA standard temperatures during the change. Temperatures as low as —100 F and as high as 200 F could be maintained. The chamber is 55 ft in diameter and 17 ft long. The internal volume is 7500 cu ft. The chamber is of sufficient size to house a complete fuselage of a pursuit airplane. The meeting was attended by 35 and considerable interest was shown in the question and discussion period.

Aviation-Management[6]

"Aircraft Organization" was discussed by John W. McFarland of the division of organization and control of Lockheed, at the management session.

As a constructive approach to solving some of the special problems of aircraft organization, he named central structural planning and control, establishment of firm policies, written delegation of authorities and responsibilities, supervisory job description and standardization, supervisory salary evaluation, program for selection of key personnel, cost-

[5] Reported by Chairman W. W. Reaser and Assistant Chairman W. Tripp.

[6] Reported by Chairman V. L. Peickii.

control budgets, work measurement, follow-up, and internal auditing.

Well-defined functions and short lines of communications summarize the most important organization objectives in the industry, he said.

A. M. Rawn's paper, "Collective Bargaining for Professional Engineers," was followed by a most intensive discussion. A strong feeling against a union of engineers was generally expressed.

"Work Simplification in Low-Quantity Manufacturing," was discussed by E. C. Osborn, addressing the management session Wednesday evening. Mr. Osborn is assistant manager of the tool-engineering division of Lockheed Aircraft Corporation at Burbank, Calif.

Work simplification is a term applied both to operation analysis and motion study, the speaker said. Its aim is the improvement of methods which will result in a reduction of costs. Simply put, it is an organized way of achieving "short cuts."

Its application to low-quantity complex products is lagging, declared Mr. Osborn. He ascribed this lag to various causes: management and engineering complacency, resulting from huge production achievements; lack of sufficient methods engineers and systems analysts to cover the multiplicity of operations; the present "production first—costs don't matter" attitude; and such usually present difficulties as resistance to change, inertia, and failure to stop going activities.

"Problems are developing which must be solved, and work simplification can help solve them," said Mr. Osborn. "Among these problems are decrease in output per direct and indirect man-hour in many industries, high overhead rates, and lack of an approach for a constant, organized increase in efficiency.

An organization which intends to increase its competitive competence must organize and execute a work-simplification plan with the following essentials, said the speaker:

1 Fixed reponsibilities for methods improvements on all work, at all levels of management—starting at the top.

2 Fixed responsibilities for methods engineers and establishment of a clear-cut relationship between them and supervision.

3 Thorough training on "how" to meet the responsibilities assigned.

4 Establishment of recognition and incentive for accomplishment.

5 A real selling job from top management on "why" reduce costs.

Aviation-Metals Engineering

In a paper, "Distortion Due to Contour Forming of Extrusions and Sheet-Metal Sections," by William Schroeder, presented at the metals-engineering session, contour forming was classified. A number of the commonly used methods of forming were analyzed. Equations for computing approximate values for change in radius due to springback were derived and sample calculations were presented. Equations for predicting the radius of transverse curvature resulting from springback were also presented by Mr. Schroeder.

In a paper, "Modern Methods in the Heat-Treatment of Steel," by E. R. Mertz, the construction of time-temperature-transformation curves (S-curves) and their use in developing the interrupted quench processes were explained. Of these processes, martempering, austempering, and cyclic annealing were explained in detail. Martempering results in greatly reduced stresses as compared to the conventional quench and temper method of hardening steel, and hence much less cracking and distortion is apparent.

Austempering, an isothermal process producing Bainite, develops surprisingly high impact properties in the region of 250,000 psi or 50 Rockwell C. Cyclic annealing is an elevated-temperature isothermal annealing process to produce a predetermined degree of softness. This is of advantage in facilitating certain machining operations.

The use of hardenability curves in establishing size limitations for particular heats of steel and in selecting accurate tempering temperatures was demonstrated.

Aviation-Production

Mr. Aron in his paper on "College Instruction in Standardization," presented at the second aviation-production session, pointed out that standardization affected many people and it was necessary to train men and women for authoritative positions in this field. The recent Chicago International Congress on Air Transport was cradled in a situation which literally begged for standardization and interchangeability, for economical maintenance, for operational safety, and most important, for mutual understanding of the other man's problems. This last was one of the greatest benefits of a continuously maintained standards program.

The subject would not have been out of place in the San Francisco Security Conference, the speaker said. A good many international problems could be handled by engineers better than by diplomats; also, an engineer in an executive position, especially a national or international one, was a better engineer and a better executive if he had a sound understanding of standardization. The college classroom and workshop was a good place to begin that understanding.

Concerning education in standards and interchangeability, the speaker held it desirable to teach the idea instead of the subject in detail. He noted that in the old system of instruction of apprentices by a master mechanic the idea of established practices was made to appear as law to the apprentice.

B. C. Bolton, in his paper "Standardization and Interchangeability," pointed out that standardization was one important answer to the increasing complexity and multiplicity of today's technical developments. Some aspects of these were so great as almost to overwhelm us, or at best to serve as a serious drag on our industrial efficiency unless brought under control by organization and systemization of details.

In the aircraft industry the principles of standardization have reached far beyond "hardware" or simple parts into important items of equipment and airplane components formerly tailored to each plane. Citing many examples from his own and other aircraft industries of benefits obtained, the speaker said: "These benefits are not intangible and not long range; they are here and now; they do not stop but are permanent gains paying dividends month after month. In the postwar period it will be the individual company's money on fixed-price contracts which will be saved."

Aviation Gas Turbines and Jet Propulsion

The second session on gas turbines and jet propulsion was presided over by Dr. M. J. Zucrow, assisted by A. A. Austin. The attendance was 450.

C. D. Flagle, design engineer, Westinghouse Electric Corporation, in a paper, "The Place of the Gas Turbine in Aviation," said the fundamental differences between the gas turbine and the conventional reciprocating engine as prime movers made it possible to state the fields of aircraft application in which each was likely to excel. A further comparison of the gas turbine driving a propeller with one used as a jet-propulsion engine led to a prediction of the types of application into which the jet and the propeller would fall. It was concluded that the gas turbine driving a propeller had characteristics which gave it superiority over both the reciprocating engine and the jet engine in all but low-speed, low-power aircraft and short-range very high-speed planes.

The background for this conclusion was essentially the fact that the gas turbine was not limited in the power it could be designed to produce, whereas reciprocating engines had reached a point of complexity where further large increases in power output were at the expense of increase in specific weight and specific fuel consumption. High-speed airplanes called for high-power engines, he said, and the gas turbine could meet the demand. Another important point was that the gas turbine could be made physically small and would not have the form drag of the conventional engine, nor would it have cooling drag. As a result, even though engine efficiency based on shaft power was not as high as that of the conventional engine, the propulsive efficiency based on thrust power expended on the airframe was higher. At low speeds, engine drag was not significant, and the conventional engine showed to advantage.

A comparison of propeller and jet efficiencies, he said, showed that flight speeds of 450 to 500 mph must be reached before the efficiencies would be equal. However, the light weight and simplicity of the jet engine, with its good high-speed performance, made it applicable to types of aircraft in which flash performance and high cruising speed, within a range of 500 miles, were essential.

The long-range characteristics of a large, modern, cargo plane had been investigated, he asserted, substituting first, gas-turbine propeller engines, then jet engines, for its supercharged reciprocating engines. It was found that the range and cruising speed of the plane were substantially increased by the use of gas turbines driving propellers, and that the take-off and climb characteristics were much improved. The jet-propelled version of the same plane had approximately half the range of the conventionally powered plane, but its best cruising speed was 100 mph higher. It was apparent that the jet-propelled plane could carry a greater amount of cargo per unit time over short ranges, and for this reason deserved the attention of commercial as well as military aircraft planners.

In a paper, "The Gas Turbine in Aviation—Its Past and Future," by S. R. Puffer and

J. S. Alford, General Electric Co., it was pointed out that newspaper releases of the past few months had shown the tremendous importance that aircraft gas turbines were acquiring. The impression might be gained that this type of power plant was something entirely new were it not for the fact that most authors on the subject were careful to point to the accomplishments of Hero of Alexandria and John Barber of England, thereby demonstrating "there is nothing new under the sun." New engineering advances, especially better materials, have occurred, however, to make possible the recent progress of the aircraft gas turbine.

In the development of alloys for operation at high temperatures, the metallurgists had made and were continuing to make outstanding contributions and as a result of these advances spurred by the war emergency, the aircraft gas turbine was now at the forefront of aircraft power-plant development.

The first successful application in this country of a gas turbine to an aircraft power plant occurred in September, 1918, when Dr. Sanford A. Moss, with a group of Army Air Corps representatives from McCook Field, took the first turbosupercharger, installed on a Liberty motor, to the top of Pikes Peak for test under altitude conditions. On this occasion it was demonstrated that the output of the Liberty engine, which was calibrated at 350 hp at sea level, was not only maintained but actually increased to 380 hp at an altitude of 14,100 ft.

Aviation-Production

At the third aviation production session F. R. Adler discussed "Production Control and Its Scope." He pointed out the scope of production control and its relationship to the fabrication and assembly plant. Numerous examples were given to illustrate various phases of the subject.

Aviation-Applied Mechanics-Instruments and Regulators

In a paper, "Mechanical Oscillators and Their Electrical Synchronization," by B. J. Lazan, S. W. Herwold, and R. W. Gemmell, presented at the Aviation-Applied Mechanics-Instruments and Regulators Session, it was pointed out that mechanical oscillators provide an excellent means for obtaining structural serviceability tests. The adjustable-while-running type is particularly flexible. With it the solutions of certain fundamentally difficult problems can be obtained quickly.

The electrical system presented provides accurate remote control of frequency and phase angle between forces of two or more mechanical oscillators. In addition, means are incorporated for remotely changing and indicating the amount of unbalance of each oscillator unit. "Rototrol" units used with electronic and magnetic controls are the basic elements of this precise serve-system.

Paul Lieber and D. P. Jensen, in their paper, "An Acceleration Damper; Development, Design, and Some Applications," stated that an acceleration damper was essentially an impact damper, consisting of a mass particle within a container such that the particle had specified freedom to move relative to the container. The efficiency of the damper depended critically on the freedom of the particle relative to its container. The energy of the mass particle which was energized by its container, was dissipated in impact.

The mechanism and theory of the acceleration damper was discussed and developed in this paper. The theory yields formulas from which the acceleration damper can be designed efficiently for specific application. Theory and procedure for calculating the motion of a mechanical system as influenced by a given acceleration damper were developed. Tests were conducted and the agreement between theory and experiment was found to be good. These results showed that friction forces acting on the mass particle were detrimental to the efficiency of the damper. Finally, a method for calculating the effect of the acceleration damper on flutter was also developed, which was accompanied by numerical results related to an actual airplane. It was indicated that the acceleration damper might have fundamental and numerous applications, some of which were: fatigue, helicopter vibration control, aircraft vibration control in general, and facilitating flight testing for flutter without endangering aircraft.

In a paper, "Charts for Fuselage Torsion vs. Control Surface Flutter," W. T. Thomson pointed out that flutter stability of control involving fuselage torsion was mainly a function of the control surface product of inertia. Stability for this form of flutter was investigated in terms of nondimensional parameters and presented in chart form. The charts are applicable to conventional tail surfaces with 20 or 33 per cent aerodynamic balance and are intended to aid in the preliminary determination of the allowable unbalance in the control surface product of inertia. Aerodynamic coefficients and computational forms suitable for developing similar charts for other ranges were also included.

Aviation Power Plants[7]

R. S. Farr, discussing "Carburetor Air Filters on Military Aircraft," emphasized the possible increase in engine life by using filters when operating from dusty fields and the desirability of designing air intakes to eliminate the ramming of dusty air into the intake. Filters installed at an angle to the duct axis cause higher pressure drop. Filter testing and developments resulting therefrom have now raised filter-face velocities to 1500 to 1700 ft per min. Dust-holding capacity was stated to be a function of surface area of filter media, air velocity, and temperature.

Jack Intlekofer in his paper, "Aircraft Power Plant Testing and Development," broke down the aircraft power plant into the engine, its auxiliaries, and its associated blower superchargers, etc. Close co-operation between the manufacturers of the engine, auxiliaries, and the aircraft was required, he said, to get a satisfactory power-plant installation in a given airplane. Testing with accurate, carefully selected and installed instruments was the proof of any power-plant installation. Such testing was usually divided into component testing, ground testing, and flight testing. During the testing program data on servicing time could be accumulated and design changes made to improve servicing and to modify nacelle design before the installation was sold to the customer.

[7] Reported by Assistant Chairman, S. F. Duncan.

Interpretations of Safety Code for Elevators

AT the meeting on June 13, 1945, of the Sectional Committee on the Safety Code for Elevators, "interpretations" of the Code issued from July, 1944, to June, 1945, by the executive committee in tentative form, were approved and transmitted to MECHANICAL ENGINEERING for publication, as follows:

Interpretation No. 2, 1944. Speed limits where automatic gates are used. Rule 124. Sept. 7,'44.

QUESTION: Is there any speed limitation in elevators using semiautomatic gates?

ANSWER: No. The present code wording does not place any speed limit on elevators using such equipment but it is recommended that the next code revision include a speed limit where such doors are used.

Interpretation No. 3, 1944. Pullchain emergency release at landings in lieu of emergency key (Rule 124*m*). Nov. 30, 1944.

QUESTION: Is a pullchain under a break-glass cover at each landing the equivalent of the emergency key located in break-glass case at main entrance required by this rule?

ANSWER: No. It does not give equivalent protection and should not be accepted in lieu of emergency key specified.

Interpretation No. 4, 1944. Brakes on Escalators (Rule 512*f*). Nov. 30, 1944.

QUESTION: If an electrically released brake is provided on the machine, is the brake on the main drive shaft required to be electrically released or may it be manually reset after each emergency application?

ANSWER: It was not the intent of the committee to require the safety brake on the main drive shaft to be electrically released when an electrically released brake is applied to the elevator machine.

Interpretation No. 1, 1945. Use of nonflammable solvent in place of gasoline (Rule 121*iD*). Feb. 7, 1945.

QUESTION: Is the word "gasoline" used in this rule intended to prohibit the use of suitable nonflammable solvents or high-flash solvents for the purpose of removing lubricants from interlock parts?

ANSWER: No. It was not the intent to prohibit such solvents if they will remove the film of lubricant. In a similar case (Rule 230*i*, Method of Socketing) the wording is "gasoline or preferably a nonflammable solvent." The intent of the committee was identical in these two cases—to wash off the lubricant with a suitable solvent.

Interpretation No. 2, 1945. Misuse of stop switch with hand rope operation (Rule 224*u*). February 7, 1945.

QUESTION: Was it not the intent of this rule to prohibit the operation of the elevator after an emergency switch stop until the operating device has been returned to the "off" position? (Otherwise the emergency switch may be used to give continuous-pressure operation with the operating device in the "on" position.)

ANSWER: It was the intent of the committee in drafting this rule to require the return of the operating device to the "off" position before the car can again be started where the car has been stopped in any manner other than by the regular operating device. This would require the device to be returned to the "off" position following an emergency-switch stop.

D. Robert Yarnall

Nominated for President

A.S.M.E. OFFICERS *Nominated for* 1945–1946

DURING the Meeting of The American Society of Mechanical Engineers in Chicago, Ill., June 17–19, 1945, D. Robert Yarnall, co-founder and president of the Yarnall-Waring Company, Chestnut Hill, Philadelphia, Pa., was nominated by the National Nominating Committee for the office of President of the Society for the year 1945–1946.

Regional Vice-Presidents named by the Committee to serve two-year terms on the Council of the A.S.M.E. were A. R. Stevenson, Jr., Schenectady, N. Y., Samuel R. Beitler, Columbus, Ohio, and J. Calvin Brown, Los Angeles, Calif.

Regional Vice-Presidents named by the Committee to serve one-year terms on the Council of the A.S.M.E. were Rudolph F. Gagg, Paterson, N. J., Edward E. Williams, Charlotte, N. C., and Linn Helander, Manhattan, Kans.

Directors-at-Large named by the Committee to serve four-year terms on the Council were Edgar J. Kates, New York, N. Y., and J. Noble Landis, New York, N. Y.

The following are to be continued in office for the remainder of their terms and are to be redesignated as indicated:

Regional Vice-Presidents to serve one-year terms on the Council, Alton C. Chick, Providence, R. I., and Thomas S. McEwan, Chicago, Ill.

Directors-at-Large to serve two-year terms on the Council, Daniel S. Ellis, Lima, Ohio, and Arthur J. Kerr, Tulsa, Okla.

Directors-at-Large to serve one year terms on the Council, John E. Lovely, Springfield, Vt., David Larkin, St. Louis, Mo., Samuel H. Graf, Corvallis, Ore., and James M. Robert, New Orleans, La.

Members of the Committee making the nominations were: W. H. Larkin, New York, N. Y., chairman, representing Group II; Ralph A. Sherman, Columbus, Ohio, secretary, representing Group V; Fred C. Richardson, New Haven, Conn., Group I; Prof. M. C. Stuart, Bethlehem, Pa., Group III; Prof. J. B. Jones, Blacksburg, Va., Group IV; C. F. Moulton, Omaha, Neb., Group VI; Prof. F. W. Candee, Pullman, Wash., Group VII; and Prof. H. E. Degler, Austin, Texas, Group VIII.

Election of A.S.M.E. officers for 1945–1946 will be held by letter ballot of the entire membership, closing September 25, 1945.

Biographical sketches of the nominees follow on the succeeding pages.

Nominated for President

D. Robert Yarnall

D. ROBERT YARNALL, co-founder and president of the Yarnall-Waring Company of Chestnut Hill, Philadelphia, Pa., and for over a quarter of a century prominently and actively identified in an engineering capacity, was born June 28, 1878, in Delaware County, Pa., a son of Edward S. Yarnall, and of Sidney S. (Garrett) Yarnall, both of American Quaker ancestry for generations.

D. Robert Yarnall attended Westtown School and the University of Pennsylvania, from where he was graduated in 1901 with the degree of bachelor of science in mechanical engineering. He received the further degree of mechanical engineer in 1905.

Shortly after his collegiate career he went to work for the Coatesville Boiler Works and allied companies as an engineer and remained with them for five years. His next position was with Stokes and Smith Company, Philadelphia, in a similar capacity, with whom he also remained for five years. In 1912 he became vice-president and general manager of the Nelson Valve Company of Philadelphia and held this position until 1918. In 1908 with B. G. Waring, he organized the firm of Yarnall-Waring Company and has been continuously identified with the company to the present time, today holding the office of president of the company, to which duties he devotes most of his time and attention. The company manufactures power-plant specialties. He is also a director and president of the James G. Biddle Company of Philadelphia, who are manufacturers of electrical instruments.

As the representative of the A.S.M.E. he served as director and chairman of the Committee on Public Affairs of the American Engineering Council. He has been a director and vice-president of the Engineering Foundation; member and fellow of The American Society of Mechanical Engineers, having served as one of its Managers from 1917 to 1920; trustee of Franklin Institute; Engineers' Club of Philadelphia, of which he served as president for the term of 1929–1930; vice-president and director of the American Friends Service Committee; member of Sigma Xi fraternity. For eleven years he was Presiding Clerk of the Philadelphia Yearly Meeting of the Society of Friends; and is chairman of the board of directors of Pendle Hill. He is also chairman of the Committee of Westtown School. He is also a professional engineer of the State of Pennsylvania, and a member of the Engineers' Club of New York and the Philadelphia Cricket Club.

Mr. Yarnall was elected on Nov. 1, 1937, president of the United Engineering Trustees—joint agency for the four Founder Societies of Civil, Mining and Metallurgical, Mechanical and Electrical Engineers.

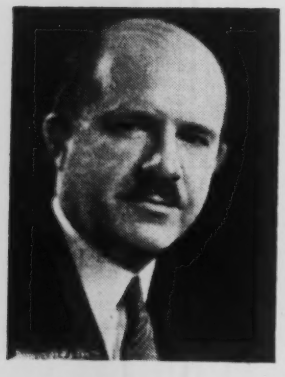
For over forty years Mr. Yarnall's work at design and construction in conjunction with his business, has resulted in many patents on valves and steam specialties. These devices, manufactured by his company, are in use in practically every government controlled steam-operated ship, as well as in all high-pressure steam-generating plants in the United States. He is the author of technical papers which have been published in MECHANICAL ENGINEERING and A.S.M.E. Transactions.

In 1941 he was awarded the Hoover Medal by the A.S.M.E., and in the following year was made Doctor of Engineering by Lehigh University.

Mr. Yarnall served as a member of the Commission in Europe having charge of feeding German children in 1920, being stationed there for about nine months, and during the latter part of his stay in Berlin served as chairman of that Commission. In 1924 he was again sent to Germany under the auspices of the American Friends Service Committee and the General Allen Committee, having charge of the liquidation of the relief program. In June, 1938, he and Mrs. Yarnall were sent by American Friends Service Committee to Austria to assist in organization of relief of refugees. In 1938–1939, for the American Friends Service Committee, he went to Berlin to protest to the German government against atrocities of 1938–1939. In 1941, he was a member of Commission to England to make survey of relief needs due to war and to consult the British Government about shipment of more food through the blockade for the aid of children and mothers of France. He was appointed a member of the City Planning Commission, Philadelphia, Pa., in 1942, and was reappointed in 1944 for a full term of five years.

Nominated for Regional Vice-Presidents

To Serve Two-Year Terms



A. R. STEVENSON, JR.

SAMUEL R. BEITLER

J. CALVIN BROWN

A. R. Stevenson, Jr.

ALEXANDER RUSSELL STEVENSON, JR., who has been nominated for the office of Regional Vice-President of The American Society of Mechanical Engineers, was born in Schenectady, N. Y., May 28, 1893. He studied at Princeton University, receiving the degree of Civil Engineer in 1914, and at Union College, obtaining his M.S. degree in 1915 and his Ph.D. degree in 1917. While in school, he worked during the summers for the American Locomotive Co., Pennsylvania Railroad, and General Electric Co. Soon after he entered the research laboratory of the General Electric Co. in June, 1917, Dr. Stevenson received a commission in the Army and was

ordered to Langley Field as officer in charge of testing. Soon thereafter he went overseas to France where he was in charge of the radio and electrical section of the Air Service, A.E.F.

Upon his return from France in 1919, he entered the power and mining-engineering department of the General Electric Co., specializing in the application of synchronous machinery to reciprocating apparatus. Not long after he was transferred to the staff of the vice-president in charge of engineering in 1923, Dr. Stevenson made the preliminary studies which led to the entrance of his company into the household-refrigerator manufacturing business. He assisted Dr. R. E. Doherty in the establishment of an advanced course in engineering at the General Electric Co., helped create the company's air-conditioning department, and co-operated in the design of the kitchen waste-disposal unit. Now as staff assistant to the vice-president, he covers mechanical engineering, development of new products, and engineering education.

Dr. Stevenson has been a member of the Society since 1927. He has been a member of the Executive Committee of the Board of Managers for the last three years. He is chairman of the Aviation Division and an advisory member of the Management Division and also of the Committee on Education and Training for the Industries. He was a member of the Publications Committee for several years. He is chairman of the S.P.E.E.'s Committee on Relations With Industry and a member of the S.P.E.E.'s Committee on Engineering Education After the War. He is a member of the Committee on Professional Recognition of the E.C.P.D. He was an A.S.M.E. representative on the Council of the E.C.P.D. for seven years. He is a past-president of the American Society of Refrigerating Engineers, fellow of the A.I.E.E., and a member of the Board of Trustees of the Brown School, Schenectady, N. Y. During the war he has been a member of the Civilian Advisory Committee of the Training Division of the Ordnance Department, and he was also a member of the first subcommittee on jet propulsion of the N.A.C.A.

Samuel R. Beitler

SAMUEL R. BEITLER, nominated for Regional Vice-President of The American Society of Mechanical Engineers, was born at Carey, Ohio, on March 19, 1899, a son of Samuel B. and Clara (Myers) Beitler. He was educated in the Carey, Ohio, schools and attended The Ohio State University from which he graduated with the degree of B.M.E. in 1920. He received the degree of M.E. from the same university in 1932.

From October, 1921, to June, 1922, he was assistant in the mechanical-engineering department of The Ohio State University. From June, 1922, to July, 1930, he was instructor in that department, and from July, 1930, to July, 1939, he acted as assistant professor. In July, 1939, he was appointed associate professor of hydraulic engineering, and in October, 1944, he was made professor of hydraulic engineering, which position he now holds. From November, 1943, to June, 1944, he served in the U. S. Army, A.S.T.P., 5th Service Command (Civil Service), as expert consultant on inspection of Basic School.

His career in industry began in June, 1920, when he was engineering apprentice in the design and checking engineering department of the Whiting Corporation, Harvey, Ill. He was with that concern until August, 1921, when he became associated with the Kilbourne and Jacobs Manufacturing Company, Columbus, Ohio, as designer and checker. From June until October, 1926, he acted as engineer and inspector for the Athletic Board, The Ohio State University, on stadium heating and shower-water installation. From June, 1931, to December, 1931, he was in charge of the design, construction, and testing of special canning machinery for the Scott-Viner Company, Columbus, Ohio. He was in charge of survey of a waterworks system as consulting engineer for the City of Lancaster, Ohio, from May, 1931, to June, 1931. In December, 1931, he entered the field of general consulting, and acted as consulting engineer and supervisor of commercial calibration of large meters for the Bailey Meter Company, Cleveland, Ohio. He was also consulting engineer on miscellaneous gas-engineering and measurement problems for the Columbia Engineering Corporation and the Ohio Fuel Gas Company. In October, 1944, he was in charge of the testing of a line of propeller pumps and turbines for the Economy Pump Company, Hamilton, Ohio, and in April, 1945, he became consulting abstractor for the Army Air Forces Technical Data Digest.

Professor Beitler has conducted and supervised researches on flow of fluids and fluid measurement carried on over a period of nearly twenty years, writing eight papers, some in collaboration with other investigators, presented to the A.S.M.E. Among these were many investigations and reports on gas measurement made for the American Gas Association and the A.S.M.E.

His publications include a textbook "Hydraulic Machinery," published by John H. Swift and Company, 1942, Bulletin No. 89 May, 1935, for The Ohio State University Engineering Experiment Station, and numerous papers written for the A.S.M.E. He is the holder of patents on apparatus for measuring pulsating fluids and for compensating gas-meter readings.

Since joining the A.S.M.E. in 1923, Professor Beitler has served as member of the Executive Committee, Columbus Local Section in 1928, and again from 1935 to 1938. He was chairman of the Section from 1937 to 1939, and chairman of the Committee on the Preparation of the Constitution in 1936. He was Columbus representative on the Sections Delegates Conferences from 1929 to 1934 and in 1936; secretary of the Conferences from 1933 through 1935, and chairman of the Conference in 1936; he was representative of the Conference at the Annual Meetings in 1934, 1936, and 1937, and secretary of representatives in the latter year. He served on the Committee on Constitution and By-Laws for the Society and was a member from 1937 to 1941, and again from 1942 to 1943; he was chairman in 1941 and 1943, and acting chairman in 1942. He served as an alternate on the Local Sections Committee in 1942 as a member in 1943 and 1944, and chairman in 1944. He has been a member of the Special Research Committee on Fluid Meters since 1931, serving also as a member of Subcommittee on Orifice Meter Research, Subcommittee on Flow Nozzle Research, chairman of Subcommittee on Pulsating Flow, and alternate on the A.S.A. Committee on Standardization of Symbols.

His other technical organization affiliations include the S.P.E.E., A.A.U.P., and N.A.P.E. of which latter he is an honorary member. He is a member of Tau Beta Pi, Sigma Xi, Pi Mu, Epsilon and Texnikoi.

J. Calvin Brown

J. CALVIN BROWN, nominated for the office of Regional Vice-President of The American Society of Mechanical Engineers, attended public and high schools in Los Angeles and the California Institute of Technology.

He studied law at Hamilton College where he received the degrees of L.L.B. and L.L.M. He also attended special courses at Southwestern University and the University of Southern California, with an additional course in petroleum at the Petroleum Institute.

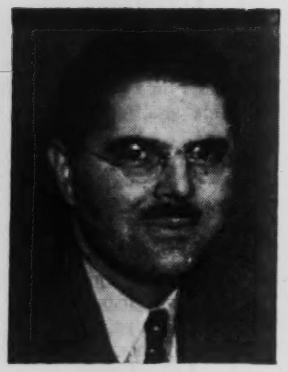
Mr. Brown is attorney at law and mechanical engineer, specializing in patent, trademark, and copyright litigation before the United States Courts. At the present time he is actively engaged in the preparation of a Proposed Professional Engineers' Act for the State of California. He is a member of the bars of the U. S. Supreme Court and of the highest courts, both State and Federal, in California, Illinois, and the District of Columbia.

He became a member of the Society in 1928 and was chairman of the Entertainment Committee at the A.S.M.E. Semi-Annual Meeting in Los Angeles, Calif., in 1938. He was chairman of the Southern California Section from 1941 to 1943; chairman of the Nominating Committee, Southern California Section, in 1944 and 1945, general chairman of the A.S.M.E. Semi-Annual Meeting in Los Angeles in 1943, and a Manager of the Society in 1943 and 1944. He was also general chairman of the War Production Board Meeting in Los Angeles in 1943.

Mr. Brown is also president of the Los Angeles Engineering Council of Founder Societies; chairman, Los Angeles Bar Association, Patent Section; past-president, Los Angeles Patent Law Association, and a member of the various sections of the American Patent Law Association, The American Bar Association, and California State Bar Association; vice-president of the Adventurers Club; an active member of the Society of Motion Picture Engineers, and of various social clubs in and around Los Angeles, including Town Hall. He is chairman of Engineers, 7th War Loan Drive, and an appeal agent of the Selective Service System.

Nominated for Regional Vice-Presidents

To Serve One-Year Terms



RUDOLPH F. GAGG

EDWARD E. WILLIAMS

LINN HELANDER

Rudolph F. Gagg

RUDOLPH FARWELL GAGG, nominated for Regional Vice-President of The American Society of Mechanical Engineers, was born in Denver, Col., in 1902. He attended the University of Colorado on a four-year scholarship. After receiving his B.S. degree in 1923 he attended the Sheffield Scientific School at Yale University for two years of postgraduate work and received the M.E. degree.

In 1925 he started his professional career in experimental engineering as junior engineer in engine development work with the Climax Engineering Company in Clinton, Iowa. After two years spent in Diesel-engine development he worked for two years on gasoline engines for industrial use and was made assistant chief engineer. He also made a thorough market survey for use in planning the future manufacturing and marketing policies of the company.

In 1930 he entered the Wright Aeronautical Corporation as senior test engineer and was shortly advanced to experimental engineer in charge of the fabrication and testing of experimental aircraft engines. In 1934 he was made assistant chief engineer and added administrative work to his experimental-engineering duties. The organization of test procedures and construction of special apparatus for use in engine research work was an important part of this work. He initiated an extensive training program for junior engineers which has proved to be an important influence in developing additional technical personnel needed to sustain the company's part in the war program.

In 1940 he was transferred to the staff of the general manager of the Wright Aeronautical Corporation. As a part of plans for manufacturing expansion to meet increasing requirements of military aviation, he conducted a survey of available plant facilities which led to a specific course of expansion over the ensuing period. This plan called for maximum utilization of near-by vacant plant facilities prior to construction of new buildings. In the subsequent course of this work, thorough plant-location studies were made before determining upon a site for an aircraft-engine-manufacturing plant in Ohio. This very large construction program was accomplished under his supervision and was unique for the times in that it was accomplished within a preplanned budget. The results achieved were used as a yardstick by government officials in measuring the performance of others.

During this period of construction activity he was drafted to act as consultant to the National Advisory Committee for Aeronautics on the design of its new Aircraft Engine Research Laboratory in Cleveland, which is the most extensive research equipment project ever undertaken at one time.

He has been an active member of The American Society of Mechanical Engineers since 1923 and has served on various committees, including the committees on Meetings and Program, Publications, and Finance. He also served on the Executive Committees of the Production Engineering and the Aviation Divisions. He was elected vice-president of the Society in 1943 and in that office now serves as vice-chairman of the Executive Committee of Council and chairman of Board of Technology. He is a Fellow of the Institute of Aeronautical Sciences and is a member of the Society of Automotive Engineers, Tau Beta Pi, and Sigma Xi.

Edward E. Williams

EDWARD E. WILLIAMS, nominated for Regional Vice-President of The American Society of Mechanical Engineers, was born at Birmingham, Ala., March 25, 1892. He attended Birmingham High School, and graduated from the Georgia School of Technology in 1914, with the degree of B.S. in electrical engineering.

He was employed in the student engineering department of the General Electric Company, Schenectady, N. Y., from July 15, 1915, until March 15, 1920. During the last 18 months of this period he was head of the steam-turbine test department of the Schenectady Works. He resigned to accept the position of municipal superintendent with the Water and Light Commission, Greenville, N. C., in charge of design, construction, operation, and management of municipal utilities. He resigned this position on April 1, 1924, to become general superintendent of steam plants of the Southern Power Company, now the Duke Power Company, in charge of operation and maintenance of steam-electric generating stations of the Duke Power System in the Piedmont Section of North and South Carolina, which position he holds at the present time.

Mr. Williams has been a member of the A.S.M.E. since 1924. He was chairman of the Charlotte Section, now Piedmont Section, in 1928. He has served on various A.S.M.E. Committees and has been active in North Carolina Sections and Student Branches. He was elected Manager of the Society on June 18, 1945, to serve the unexpired term of H. G. Thielscher. He is a member of the North Carolina Society of Engineers and past-president of the Charlotte Engineers Club, 1932.

He became a registered engineer, State of North Carolina, in 1924.

He is the author of articles published in *Southern Power and Industry*, describing Riverbend and Cliffside Steam Stations of Duke Power Company, and of an article entitled "Operation and Maintenance of the Modern Steam-Electric Generating Station," published in the *North Carolina Engineer*.

Linn Helander

LINN HELANDER, who has been nominated for Regional Vice-President of The American Society of Mechanical Engineers, is professor of mechanical engineering and head of the department of mechanical engineering of Kansas State College. He served as Manager of the Society from 1939 to 1942 and as a member of the executive committee of the Kansas City Section of the Society from 1935 to 1939. He was vice-chairman of the Kansas City Section for the fiscal year 1936–1937 and chairman for the fiscal year 1937–1938. Last year he again served as a member of the Section's executive committee. Since 1941 he has been an advisory member of the Society's Committee on Education and Training for Industry. He was chairman of the Semi-Annual Meeting of the Society held in Kansas City in 1941. From 1936 to 1938 he was honorary chairman of the Kansas State College Student Branch of the A.S.M.E., and last year he again served in that capacity. In 1936 he served as a dele-

gate from Kansas State College to the Third World Power Conference, Washington, D. C., and from 1936 to 1938 as a member of the executive committee of the Kansas Engineering Society.

Professor Helander was born in Chicago, Ill., August 28, 1891, and was graduated from the Yeatmen High School in St. Louis in 1910 and from the University of Illinois in 1915 with the degree of B.S. in mechanical engineering.

For a brief period after graduation Professor Helander worked as a member of a group investigating stresses in railroad rails, under the direction of Prof. A. N. Talbot, and then entered the employ of the Pittsburgh Crucible Steel Company, Midland, Pa., as a steam engineer. From 1917 to 1918 he was on the editorial staff of the *Iron Age*, and from 1918 to 1919 he was assistant engineer of tests, Ordnance Department, U. S. Army, with supervisory responsibilities in the Montreal District. In 1919 he became a general engineer with the Westinghouse Electric and Manufacturing Company, where he made extensive studies of the use of regenerative feedwater heating, higher pressures and temperatures, and reheating.

From 1925 to 1929 Professor Helander was a senior engineer with the U.G.I. Contracting Company, Philadelphia, Pa., now United Engineers and Constructors, and from 1929 to 1931 was employed first by the Westinghouse Company on a special assignment, and then by the Champion Fibre Company, as a consultant. In 1931 he became assistant professor of mechanical engineering at the University of Pittsburgh and in 1935 was appointed to his present position of professor and head of the department of mechanical engineering at Kansas State College. From 1933 to 1935 he was engaged in private practice in Chicago as a consulting and research engineer.

Professor Helander joined the A.S.M.E. as a junior in 1916 and became a full member in 1924. He is a member of The Franklin Institute, American Association for the Advancement of Science, American Academy of Political and Social Science, Kansas Engineering Society, The Newcomen Society of England, Society for the Promotion of Engineering Education, Sigma Xi, Tau Beta Pi, Phi Kappa Phi, and Pi Tau Sigma.

Professor Helander has contributed widely to the technical literature on subjects related to economic and thermodynamic factors in steam-power generation.

Nominated for Directors-at-Large

To Serve Four-Year Terms

EDGAR J. KATES

J. N. LANDIS

Edgar J. Kates

EDGAR J. KATES, who has been nominated for the office of Director-at-Large of The American Society of Mechanical Engineers, was born in New York, N. Y., on August 1, 1889. After attending the New York City grade and high schools, he entered Columbia University in 1905, and received the degrees of Bachelor of Arts in 1909 and Mechanical Engineer in 1911.

He was engaged in 1911 by the De La Vergne Machine Company, New York, N. Y., as draftsman in the oil-engine department, later becoming designer, test engineer, and assistant chief engineer. He held the position of chief engineer from 1917 to 1926, with responsibility for design, manufacture, and erection of numerous Diesel engines, as well as the design and construction of complete power plants for industrial, municipal, commercial, and public-utility applications. He resigned in 1926 to enter his present practice as consulting engineer specializing in Diesel engine design and power plants, and also public-utility rate investigations.

Mr. Kates was consultant on the first fully automatic Diesel-electric plant in 1930. He has done much work on joint use of Diesel and steam engines to balance heat and power, and presented a paper on this subject before the A.S.M.E. in 1930. During the present war he has designed several large Diesel power plants for the U. S. Naval Bases in the Panama Canal Zone.

He was a lecturer on Diesel engines at Brooklyn Polytechnic Institute, Brooklyn, N.Y., from 1927 to 1930. He is the author of "Diesel-Electric Plants," published 1936 and 1945 by the American Technical Society, Chicago, Ill.; the Diesel engine section of Kent's "Mechanical Engineers' Handbook," eleventh edition, published 1936 by John Wiley & Sons, Inc., New York, N.Y.; and many articles in the technical press. He has been a licensed professional engineer, New York State, since 1923.

Mr. Kates has been active in the Oil and Gas Power Division of the A.S.M.E. since that Division's organization in 1921, serving as its chairman from 1925 to 1929, and again in 1938. He has been a member of the Oil Engine Power Cost Committee since its organization in 1927; a member of the Power Test Codes Committee on Internal-Combustion Engines since its reorganization in 1939. He has served on the Standing Committee on Publications since 1938 as advisory member and member, and is now its chairman.

J. N. Landis

J. N. LANDIS, assistant mechanical engineer of the Consolidated Edison Company of New York, Inc., New York, N. Y., and a candidate for the office of Director-at-Large of The American Society of Mechanical Engineers, was born at Champaign, Ill., August 18, 1899. He attended the College of Engineering and Architecture of the University of Michigan from 1917 to 1922, graduating with a Bachelor of Science degree in Mechanical Engineering. During 1921 and 1922 he was instructor in mathematics in the College of Engineering and Architecture. After a short period in Indianapolis, Ind., with Nordyke and Marmon and the Indiana Public Service Commission, he became associated with the Brooklyn Edison Company as technical assistant to the mechanical engineer. He worked through various grades in that company, becoming mechanical engineer in 1932. In 1937 he was transferred to the parent company, Consolidated Edison Company of New York, Inc. For about two years he was manager of the contract control and inspection department and in the fall of 1938 was made assistant mechanical engineer of the company.

Mr. Landis has served as program chairman and executive committee chairman of the Metropolitan Section of the A.S.M.E. and on various national committees, namely, Special Research Committee on Fluid Meters, Power Test Codes Committee No. 6 on Steam Turbines, Special Committee on Policies and Budget, Professional Engineers Committee on Employment, Standing Committee on Local Sections, National Nominating Committee, Committee on Society Office Operation, Special Committee on Radio Talks on Engineering Subjects, Board on Technology, Committee on Engineers' Civic Responsibilities, Special Committee on Industrial Conservation, Special Committee on Economic Status of the Engineer, Postwar Planning Committee, Power Division, Executive Committee, Special Research Committee on the Detonation Propulsion Engine, and Finance Committee.

Nominated for Regional Vice-Presidents

Redesignated to Serve One-Year Terms

ALTON C. CHICK

THOMAS S. MC EWAN

Alton C. Chick

ALTON C. CHICK, who continues in office for the remainder of his term of one year as Manager, and who has been redesignated Regional Vice-President of The American Society of Mechanical Engineers, was born in Limerick, Maine, October 26, 1896. He received his B.S. degree from Brown University in mechanical engineering in 1919 and his M.S. degree in civil engineering in 1926.

During his junior year at Brown University, Mr. Chick enlisted in the U. S. Navy. He was placed on inactive duty to attend a ten weeks' course in mechanical engineering at Brown University thus completing his senior year's work in that time. After this course, he was assigned to the U. S. Navy Steam Engineering School, Stevens Institute of Technology, Hoboken, N. J., from which he was commissioned an Ensign, and assigned to sea duty on the naval transport *U.S.S. Montpelier*. In June, 1919, he was honorably discharged from the Navy and was invited to return to Brown University in September of that year to serve as an instructor in mechanical engineering, which position he held for two years. The summer vacation of 1920 was spent by Mr. Chick as a draftsman in the Philadelphia Inspection Department of the Associated Factory Mutual Fire Insurance Companies, and in June, 1921, he returned to this Inspection Department and spent the following year inspecting industrial plants in the states from New York to Florida.

In June, 1922, Mr. Chick became principal assistant to John R. Freeman, consulting engineer and president of six of the Associated Factory Mutual Fire Insurance Companies. He remained with Mr. Freeman until his death in October, 1932. During this ten-year period he had an opportunity to work on many and varied engineering problems.

Just prior to Mr. Freeman's death in 1932, Mr. Chick undertook to recompute an extensive series of experiments on the flow of water in pipes and pipe fittings that were made by Mr. Freeman at Nashua, N. H., in 1892. Unfortunately, Mr. Freeman died before this work could be completed, but after his death the work was carried on by others under the supervision of Mr. Clarke Freeman and Mr. Chick, and the results were published by the A.S.M.E. in 1941, in a volume of 349 pages entitled "Experiments Upon the Flow of Water in Pipes and Pipe Fittings."

After Mr. Freeman's death, Mr. Chick accepted a position as engineer with the Manufacturers Group of six Fire Insurance Companies, later merged, in July, 1941, in the one company, known as the Manufacturers Mutual Fire Insurance Company. In January, 1938, he was made assistant vice-president and engineer of the company, the position which he now holds. His work with the insurance company involves application of engineering principles to the prevention of fire and the protection of industrial plants against interruption of production and loss by fire and other perils. His duties also involve the underwriting and rating of fire-insurance risks valued at over $5,300,000,000.

Mr. Chick joined the Society as a junior in 1921 and became a member in 1934. He has served as a member of the Executive Committee of the Providence Section of the A.S.M.E. and was its chairman 1934–1935. He was a member of the A.S.M.E. Committee on Relations With Colleges from 1937 to 1942 and was chairman of this Committee during the fifth year.

He has served on various committees and in various official capacities for the Providence Engineering Society and was its president during the year of 1937-1938. He was treasurer of the Alumni Association of Brown University from July, 1937, to July, 1943, and also served as vice-president of the Brown University Engineering Association. Mr. Chick was treasurer of the Eastern Section of the Seismographical Society of America for three years, from 1937 to 1939.

At present Mr. Chick is a member of the Providence Law Revision Committee, appointed by Mayor Roberts in January, 1942, to draft a new building code for the city of Providence. He served also as a member of the Staff of the Civilian Defense Council in both the city of Providence and State of Rhode Island. He was deputy director of the utilities division of the Providence CD Council and a member of the utility division of the State Council. During the past two years Mr. Chick has served as a Manager of the Society and has been a member of the Executive Committee both years.

Thomas S. McEwan

THOMAS SPRING McEWAN, consulting management engineer of Chicago, Ill., who continues in office for the remainder of his term of one year as Manager, and who has been redesignated as Regional Vice-President of The American Society of Mechanical Engineers, was born on April 1, 1889, in Jersey City, N. J. After the usual education in grade and high schools, he entered Cornell University from which he was graduated in 1911 with the degree of mechanical engineer.

His first position was as engineer in the West Lynn, Mass., plant of the General Electric Company. In 1915, he became assistant sales manager of the SKF Manufacturing Company, being stationed in New York, N. Y.,

and Hartford, Conn. When the United States declared war in 1917, he saw service as a Second Lieutenant in the Aviation Section, S.R.C., U. S. Army. Upon his discharge from the Army, he accepted a position as Chicago district sales manager with the Cowan Truck Division, Yale & Towne Manufacturing Company.

In 1925 Mr. McEwan joined the Haynes Corporation, Chicago, Ill., as a consulting management engineer and senior vice-president. In 1933 he became connected with Stevenson, Jordan and Harrison, New York and Chicago, becoming Midwest resident manager-engineer. His work throughout the Middle West has covered all phases of management and engineering. Until 1941 and subsequent to his government job, he continued with this type of work as vice-president of McClure, Madden and Ortman, Chicago, Ill.

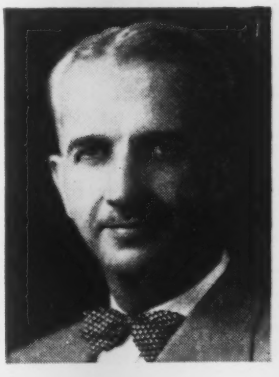
Because of his extensive knowledge of the facilities, equipment, and personnel possessed by plants throughout the Chicago area, Mr. McEwan, early in 1941, was selected to set up and head the War Production Board in the Seventh Federal Reserve District as Regional Director, with headquarters in Chicago.

He has been a member of the A.S.M.E. since 1915. Despite the many duties in connection with his work, Mr. McEwan has found time to take part in the activities of the Chicago Section, serving as chairman for three years, 1936–1938. In 1943 he helped organize the Chicago Technical Societies Council, of which he has been president for two years. He is also a past-president of the Cornell University Club of Chicago.

Nominated for Directors-at-Large

Redesignated to Serve Two-Year Terms

DANIEL S. ELLIS



A. J. KERR

Daniel S. Ellis

DANIEL S. ELLIS, who continues in office as Manager for the remainder of the current year, and who has been redesignated as Director-at-Large of The American Society of Mechanical Engineers, was born at Warwick, N. Y., on January 25, 1897, and attended the Warwick High School. In 1916, he became a clerk in the auditor's office of the Lehigh & Hudson River Railway and in the following year was appointed a clerk in the office of the auditor of freight accounts of the New York Central Railroad. Later he served as a machinist and as an acting enginehouse foreman.

In 1918, Mr. Ellis became a draftsman, serving in this position and as an engineer, calculator, designer, and traveling engineer until 1924. In that year, he was appointed assistant engineer of motive power, New York Central Lines. On May 1, 1929, he left the employ of the New York Central and accepted the position of eastern district manager, and subsequently manager, of the railroad division of the Worthington Pump and Machinery Corporation. On October 1, 1932, he resigned from the latter position to become engineer of motive power on the Advisory Mechanical Committee of the Chesapeake & Ohio; Erie; New York, Chicago & St. Louis; and Pere Marquette railways, with headquarters at Cleveland, Ohio.

In January, 1936, Mr. Ellis was appointed mechanical assistant to the vice-president of the C.& O., N. Y. C. & St. L., and P.M. railways with headquarters in Cleveland, and in July, 1936, was appointed chief mechanical officer of the same roads, which position he held until May 1, 1943, on which date he resigned to become vice-president in charge of manufacture, Lima Locomotive Works, Incorporated, Lima, Ohio.

Mr. Ellis has served as a member of the General Committee, Mechanical Division, Association of American Railroads, chairman of the Committee on Further Development of Reciprocating Steam Locomotives, and on various subcommittees of that association. He also has been chairman of the Railroad Division of The American Society of Mechanical Engineers and is now a member of the War Production Committee of the Society. He is a member of various railroad clubs; the Newcomen Society of America and England; past-president of the Cleveland Roamers; The Chicago Club, Chicago, Ill.; The Lima Club; the International Rotary Club of Lima; and Shawnee Country Club, Lima, Ohio.

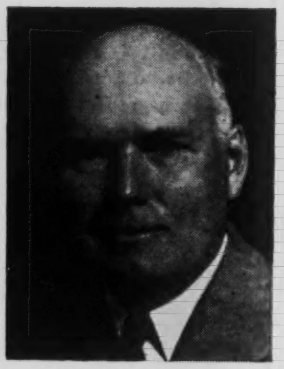
A. J. Kerr

A. J. KERR, General Sales Manager of the Pittsburgh Equitable Meter Company, Pittsburgh, Pa., who continues in office as Manager for the remainder of the current year, and who has been redesignated as Director-at-Large of The American Society of Mechanical Engineers, was born in Armstrong County, Pa., November 26, 1897, and attended public school and high school in Kittaning, Pa. He attended Carnegie Institute of Technology, Pittsburgh, Pa., from 1917 to 1920, graduating with a Bachelor of Science degree in mechanical engineering. Until April, 1921, he was a draftsman with the C & G Cooper Company, Mt. Vernon, Ohio, from which time until 1925 he was associated with the Foxboro Company of Tulsa, Okla., as a sales engineer. During the next two years he served as district manager at Tulsa for the Equitable Meter and Manufacturing Company, and from 1926–1932 in the same post after the merger of the Equitable Meter and Manufacturing Company with the Pittsburgh Meter Company. From 1932 to July, 1944, he was district manager of the Pittsburgh Equitable Meter Company, and also of the Merco Nordstrom Valve Company, with jurisdiction over the States of Arkansas, Louisiana, Texas, New Mexico, and Oklahoma. On July 1, 1944, he was appointed general sales manager for the combined organizations. In assuming his new duties, Mr. Kerr brings a wealth of sales experience gleaned from his association with equipment buyers, engineers, and operators throughout the country, as well as in his midwest territory.

Mr. Kerr has served as treasurer, secretary, and chairman of the Mid-Continent Section of the A.S.M.E. He also served for five years on the Local Sections Committee, and for eight years has been a member of the Fluid Meters Committee. He is a past-president of the Engineers Club of Tulsa and is now serving on its board of directors.

Nominated for Directors-at-Large

Redesignated to Serve One-Year Terms



OHL E. LOVELY

DAVID LARKIN

SAMUEL H. GRAF

JAMES M. ROBERT

John E. Lovely

JOHN EMERSON LOVELY, vice-president and chief engineer of Jones & Lamson Machine Company, Springfield, Vt., who continues in office as Vice-President for the remainder of the current year and who has been redesignated Director-at-Large of The American Society of Mechanical Engineers, was born August 1, 1888, at Tottenville, N. Y. He graduated from the University of Vermont, Burlington, Vt., in 1910, with the degree of Bachelor of Science in mechanical engineering; Phi Beta Kappa honors. From 1910 to 1916, Mr. Lovely was chief engineer of the Patch Manufacturing Company, Rutland, Vt., followed by a year as superintendent of the Fort Dearborn Manufacturing Company, Sterling, Ill. In 1917–1918, he supervised the manufacture of shells at the Vermont Farm Machine Company. From 1918 until the present time he has been associated with Jones & Lamson Machine Company, Springfield, Vt., of which he is now vice-president and chief engineer.

Mr. Lovely was president of the National Machine Tool Builders' Association in the period 1939–1940. He is a member of The Council of the American Standards Association; a member of the American Society of Tool Engineers; and a member of various committees of The American Society of Mechanical Engineers.

David Larkin

DAVID LARKIN, vice-president and general manager of Broderick & Bascom Rope Company, St. Louis, Mo., who continues in office as Vice-President for the remainder of the current year, and who has been redesignated as Director-at-Large of The American Society of Mechanical Engineers, was born on April 21, 1880, at Bootle, England, and received his primary education in Edinburgh, Scotland, and graduated from Queens College, Belfast, Ireland, in 1902. He came to the United States immediately thereafter and was naturalized as a citizen in 1903. From 1903–1905, he was engaged as a mechanical draftsman and assistant mechanical engineer with the New York Central Railroad. With this beginning, his career has been an active and varied one. In the years 1905–1907, he was with the Wilson Company Packing House, New York, N. Y.; 1907–1909, outside field engineer with Patterson Brothers, consulting engineers, New York, N. Y., 1909–1913, chief engineer, Fifth Avenue Building Company, New York, N. Y., in charge of operations; 1913–1915, chief mechanical and electrical engineer of various plants of the New York-Pennsylvania Pulp & Paper Company; 1915–1917, chief mechanical engineer, Fifth Avenue Building Company; 1917–1923, chief engineer in charge of all operations, Monsanto Chemical Works, St. Louis, Mo.; 1923–1928, consulting engineer in St. Louis.

During this period Mr. Larkin designed and supervised the construction of many industrial plants throughout the Middle West, outstanding among which are the Illinois Powder Company; Becker Paint & Varnish Company, Cincinnati, Ohio; Alligator Clothing Company, St. Louis; Saxony Flour Mills, St. Louis; Broderick & Bascom Rope Company; and many others.

In his present position as vice-president and general manager of the Broderick & Bascom Rope Company, which connection began in 1928, Mr. Larkin has been instrumental in enlarging and broadening the scope of the engineering staff and services of the company. He has completed a number of machinery programs for modernization of plant facilities and has been actively engaged in furthering the development and standardization of wire-rope specifications for the entire industry, as well as for specific requirements of customers of the company.

Mr. Larkin became a member of The American Society of Mechanical Engineers in 1921 and a Life Member in 1943. His activities in the Society have included past-chairman of the St. Louis Section; member of Membership Development Committee; member of the A.S.M.E. War Production Board Committee since its inception; general chairman of the First National Defense Meeting of the A.S.M.E. held in St. Louis in 1941. He also holds membership in the following societies and clubs: American Society for Testing Materials; Wire Rope & Strand Manufacturers Association; Board of Directors of the St. Louis Branch of the National Metal Trades; Navy League of the United States; Army Ordnance Association; Newcomen Society; Missouri Athletic Club; St. Louis Chamber of Commerce; American Petroleum Institute; Industrial Club of St. Louis; Advisory Board, Washington University School of Engineering, St. Louis, Mo., and a member of Enterprise Masonic Lodge No. 48, Jersey City, N. J., since 1909.

Samuel H. Graf

SAMUEL H. GRAF, who continues in office as Manager for the remainder of the current year and who has been redesignated as Director-at-Large of The American Society of Mechanical Engineers, was born in Portland, Oregon, August 4, 1887. He received his B.S. in E.E. in 1907, E.E. in 1908, B.S. in M.E., 1908, M.E. in 1909, and M.S. in E.E. in 1909 all from Oregon State College.

Since 1908 Professor Graf has been connected with Oregon State College. He started as an assistant in the mechanical-engineering department. After several years as instructor and assistant professor of mechanical and experimental engineering he was appointed head of the department of experimental engineering in 1912, and two years later, professor. From 1920 to 1934 he served as professor of mechanics and materials. From 1927 to 1944 he was director of engineering research, and in 1944 was appointed Director of the Engineering Experiment Station. Since 1934 he has been professor of mechanical engineering and head of that department.

Professor Graf has had an active consulting practice, serving as research engineer for about four years with the Portland Gas and Coke Company, in research work in safety of appliances for the American Gas Association Testing Laboratory, and as research engineer with the Iron Fireman Manufacturing Company.

He served as consulting engineer from 1935 to 1937 for the Bonneville Power and

Navigation Project and has been a consulting engineer for the Willamette Valley Project since 1936. He spent one summer conducting comprehensive tests on four suction dredges operated by Port of Portland and was test engineer in sixteen trial trips of merchant vessels built in Portland, Oregon. He was a test engineer with the U. S. Shipping Board, Portland, Oregon, for one year.

First appointed by Governor Patterson and later reappointed, Professor Graf has served as a member of the State Board of Engineering Examiners since 1927, representing the field of mechanical engineering, and has been president of the Board since 1939. He was director of the western zone of the National Council of State Boards of Engineering Examiners from 1934 to 1936. In 1936–1937 he was vice-president and in 1937–1938 he served as president of N.C.S. B.E.E.

In addition to his many outside engineering connections he has worked on many and various problems in the testing laboratories of his own department at Oregon State College. These investigations and tests have included work on structural materials, highway materials, fuels, and lubricants. He has also been engaged as consultant on inventions and a wide variety of problems brought to the college for solution.

As faculty editor of *Oregon State Technical Record* since the start of that publication, Professor Graf has contributed many semitechnical articles to its pages. He was co-author of the Gas Appliance Testing Code published by Pacific Gas Association and editor of the "Gas Engineers' Handbook," a reference work of about 1000 pages, published in 1934 by McGraw-Hill Book Company, Inc., New York, N. Y.

Professor Graf joined the Society in 1912 and is a past-chairman of the Oregon Section of the A.S.M.E., past vice-president of the Northwestern Society of Highway Engineers, past-president of the Oregon Chapter of the American Society for Metals, and a member of the Pacific Coast Gas Association. He has served twice on the Nominating Committee of the A.S.M.E. and has been honorary chairman of the A.S.M.E. Student Branch at Oregon State College.

He is a registered professional engineer of the State of Oregon and is a past-president of the Corvallis Engineers Club.

Professor Graf belongs to the honorary fraternities of Tau Beta Pi, Sigma Tau, Pi Tau Sigma, Eta Kappa Mu, Sigma Xi, and Phi Kappa Phi.

James M. Robert

JAMES M. ROBERT, who will continue in office as Manager of The American Society of Mechanical Engineers for the remainder of the current year and who has been redesignated as Director-at-Large, was born in St. Paul, Minn., June 20, 1885. He received his degree of B.E. in mechanical and electrical engineering in 1906 from Tulane University.

From 1906–1912 Dean Robert served as an instructor at Tulane University. He successively progressed at this University as assistant professor of experimental engineering, associate professor of machine design, professor of mechanical engineering, acting dean of the college of engineering, and, since 1936, dean of the college of engineering.

Dean Robert has had considerable experience as a consulting and testing engineer since 1906. In the first World War he was in charge of the U. S. Shipping Board of the Marine Engineering School at Tulane from 1917 to 1921.

He has been a member of the Society since 1920, serving as chairman of the New Orleans Section in 1923 and 1924. He was secretary of the Louisiana Engineering Society for eleven years, becoming vice-president in 1923 and president in 1924. He served as editor of the Proceedings of that society for many years.

Dean Robert is also a member of the Society for the Promotion of Engineering Education and was vice-chairman of the Southeastern Section in 1937 and 1938 and chairman 1938–1939. He served as a member of the Board of Examiners of Operating Engineers from 1934 to 1941 in New Orleans, La. He belongs to Tau Beta Pi, Sigma Phi Delta, Omicron Delta Kappa, and Pi Kappa Alpha fraternities.

Recently he has served as panel member of the War Labor Board and he is a member of the Board of Directors of the Pendleton Shipyards, Inc.

A.B.S. Elects Officers

THE 83rd Annual Meetings of the board of managers and members of the American Bureau of Shipping were held on February 6 in the Bureau's boardroom, 47 Beaver St., New York, N. Y. President J. Lewis Lukenbach presided and expressed his gratitude to more than 60 managers and members for their attendance.

Mr. Lukenbach was elected president for the thirteenth time, and the following were re-elected: David Arnott, vice-president, chief surveyor; Joseph W. Powell and William D. Winter, honorary vice-presidents; Jerome B. Crowley, treasurer; John W. Cantillion, secretary and assistant treasurer; and Kenneth D. Hull, assistant treasurer.

Proceedings of Water Conference Available

THE Proceedings of the Fifth Annual Water Conference of the Engineers' Society of Western Pennsylvania held Oct. 30 and 31, 1944, are now available. This publication contains all papers and discussions as presented at the Conference. The cost of this publication is $3.50 per copy. Copies may be obtained by writing to the society office, Hotel William Penn, Pittsburgh, Pa.

Among the Sections

Anthracite-Lehigh Valley Section Hears Talk by G. A. Stetson

AT June 22 meeting at Riverview Lodge, Northampton, Pa., George A. Stetson, editor of A.S.M.E. publications, and member of the Society, spoke on the topic "Some Ruminations of an Editor." In his talk Mr. Stetson reviewed his recollections of the engineers whom he has known in the Anthracite-Lehigh Valley area and their contributions to the profession. He then gave a short history of A.S.M.E. publications, outlining the policies which have guided them to their present high quality. An interesting and informative open discussion followed.

Bridgeport Section Has Dinner Meeting

On May 24 a dinner meeting was held at the Algonquin Club, Bridgeport, Conn., when 40 members and 26 guests were present. The toastmaster was E. P. Blanchard, and with him at the speakers' table were many of the oldest members of the Section. The speaker, George E. Hulse, a guest from the New Haven Section, addressed the audience on the duties of the Committee of Admissions, of which he is a member, and asked for aid, giving some very good suggestions that members may use in their talks to prospective members. After the dinner several films loaned by the Remington Arms Company were shown. These films depicted the hunting of various types of game and birds.

Dayton Section Learns of Dayton Technical Society Council

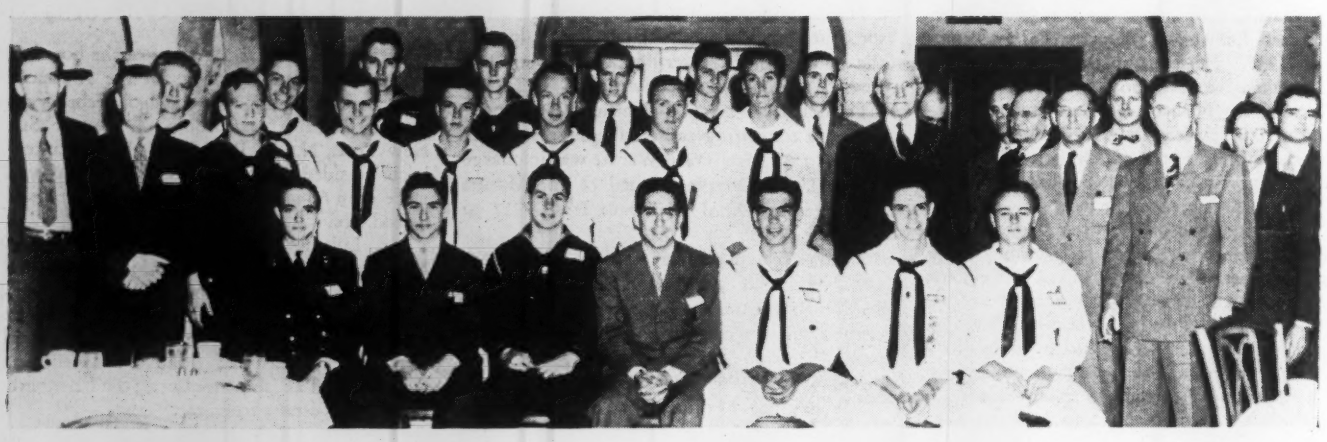
A general meeting was held on June 19 at the Engineers' Club, Dayton, Ohio, when Mr. Fritz of the Dayton Technical Society Council explained the aims of that Council and answered questions after his talk. The delegate to the 5th Regional Conference gave a report on the meeting.

Mid-Continent Section Has Lecture on Refining Industry

On May 24 a meeting was held in the junior ballroom of the Mayo Hotel, Tulsa, Okla., when the speaker was Arch L. Foster, refining editor, *Oil and Gas Journal of Tulsa*. Some enlightening facts and figures on the refining industry were given in his talk entitled "Trend of Postwar Refining." Mr. Foster pointed out that future requirements of material, equipment, and processes must necessarily be based upon data of the past and present, and can be projected only a reasonable amount into the future with any degree of accuracy.

President Alex D. Bailey Speaks at Rock River Section

The final meeting of the season was held on June 8 when Alex D. Bailey, president A.S.M.E., gave an interesting talk on the services rendered by the public utilities during the war. The newly elected chairman, E. L. Dahlund, and secretary, R. R. Smith, were presented.



GROUP ATTENDING ELEVENTH ANNUAL MEETING OF STUDENT BRANCHES, AT DALLAS, TEXAS

With the Student Branches

Group Student Meetings Held in the Spring of 1945

FOUR Group Student Meetings were held in the Spring of 1945, sponsored by Southern Methodist University, Northwestern Technological Institute, Massachusetts Institute of Technology, and Stevens Institute of Technology, respectively.

Meeting at Dallas, Texas

Southern Methodist University, Dallas, Texas, sponsored the annual meeting of student Branches, in that region on May 7, 1945, in the auditorium of the University. Represented were University of Oklahoma, Southern Methodist University, Texas A.&M. College, and The University of Texas Branches. The session was opened by Dean E. H. Flath of the school of engineering. Two technical sessions were held, a buffet luncheon, and a dinner.

Speakers at the dinner were Dean W. R. Woolrich, school of engineering, University of Texas, and Prof. H. E. Degler, representing the Council of the A.S.M.E., University of Texas. Five students contested for prizes which were awarded as follows: First prize of $60 to Jack Drandell, Southern Methodist University, for his paper "Engineering in the New South;" second prize of $45 (of which $25 was a contribution of the South Texas Section) to Robert E. Hawkins, University of Oklahoma, for his paper "An All-Year Gas-Fired Air Conditioner;" third prize of $30 to Sidney Glasser, Southern Methodist University, for his paper "Precision Casting;" fourth prize of $20 to Paul F. Woolrich, University of Texas, for his paper "Refrigerated Cargo Shipping;" and fifth prize of $10 to Curt Guernsey, Jr., University of Oklahoma, for his paper "The Gas Turbine." The presentation of awards was made by Harry R. Pearson of the Dallas Power and Light Company, representing the A.S.M.E. Committee on Relations With Colleges.

Meeting at Evanston, Ill.

Northwestern University, Evanston, Ill., sponsored the annual meeting of Student Branches in that region on May 11. Represented were Illinois Institute of Technology, University of Illinois, Iowa State College, Marquette University, Northwestern University, University of Notre Dame, Purdue University, and University of Wisconsin Branches.

Dean Ovid W. Eshbach, of Northwestern Technological Institute, gave the official address of welcome, followed by remarks from Herbert Kuenzel, representing the A.S.M.E. Committee on Relations With Colleges. Two technical sessions were held, a luncheon, and the annual banquet at which the key speech was made by President Alex D. Bailey.

Prizes were awarded to students, and these were presented by F. H. Lane, chairman of the Chicago Section. William R. Whendt, Jr., University of Wisconsin, was awarded first prize for his paper "Fifty-Thousand Radiators;" second prize to Edward Barnett, Northwestern Technological Institute, for his paper "Work Simplification in Job Shops;" third prize to John H. Colby, Purdue University, for his paper "Aircraft Flutter;" fourth prize to Robert R. Hayes, University of Illinois, for his paper "An Investigation of Metal-Cutting Temperatures;" fifth prize to John W. Erickson, Illinois Institute of Technology, for his paper "Increasing the Efficiency of Gas-Turbine Cycles;" sixth prize to Carl Richards, Marquette University, for his paper "Industry Awakens to the Versatility of Glass;" and seventh prize to Myron C. Anderson, Iowa State College, for his paper "Gas Turbines, Yesterday and Tomorrow." Attendance at the Meeting totaled 147. A group of 16 judges marked a scoring sheet for each speaker, each judge giving his opinion of the deserved number of points.

Meeting at Cambridge, Mass.

On May 12 the annual meeting of Student Branches was held at Massachusetts Institute of Technology, Cambridge, Mass. Represented were Brown University, University of Connecticut, Rhode Island State College, Massachusetts Institute of Technology, Worcester Polytechnic Institute, Northeastern University, Tufts College, University of Maine, University of New Hampshire, and Yale University Branches. The address of welcome was made by Dean Robert S. Williams, dean of engineering, Massachusetts Institute of Technology, followed by remarks by Holcombe J. Brown, representing Committee on Relations With Colleges, A.S.M.E. A technical session, current events session, inspection of engineering laboratories, and awarding of prizes, constituted the program. Prof. Otto C. Koppen, department of aeronautical engineering, Massachusetts Institute of Technology, spoke on "Aviation in the Postwar World" at the afternoon session. Alton C. Chick representing the A.S.M.E., awarded prizes to the following students: first prize of $25 to Thomas Chin, Northeastern University, for his paper "The Carbon Trigger—From Forging to Gun;" second prize of $15 to Malvin M. Yurko, Northeastern University, for his paper "The Limiting Factors in Gas-Turbine Efficiency;" third prize of $10 to Harold G. Payne, Tufts College, for his paper "Plastics;" and fourth prize of $5, the gift of the Old Guard, A.S.M.E., to Jacob Wisnik, Tufts College, for his paper "Trends in Modern Helicopters."

Meeting at Hoboken, N. J.

Stevens Institute of Technology, Hoboken, N. J., was host to the annual meeting of Student Branches in that region on May 16. Represented were Cooper Union, New York University, Polytechnic Institute of Brooklyn, Pratt Institute, and Stevens Institute of Technology. A technical session was held, followed by inspection trips around the college buildings. A banquet followed at the Union Club, with entertainment furnished by the Stevens Institute Glee Club and soloist. Visitors at the banquet were Ernest Hartford, executive assistant secretary A.S.M.E., B. R. McBath, W. Raisele, R. F. Gagg, (Council representative) Roy H. Porter, representing Committee on Relations With Colleges, and Harvey N.

Davis, president, Stevens Institute of Technology.

Prizes for papers were awarded as follows: first prize to Henry Meyer, Polytechnic Institute of Brooklyn, $30; second prize to William Rowley, Stevens Institute of Technology, $20; and third prize, Old Guard A.S.M.E., to Ronald Probstein, New York University, $10, of which $5 was contributed by the judges of the contest. Paul C. Swartz, Stevens Institute of Technology, and Joseph Adelette, New York University, were awarded honorable mention. The attendance totaled 128.

Branch Meetings

Georgia School of Technology Branch

As the Georgia School of Technology is operating on a tri-mester basis to accommodate the Naval V-12 program, the Branch concentrated its activities on visiting manufacturing plants, securing prominent speakers, and creating student interest in the professional societies, from March to June, inclusive.

A tour was made to the plant of Dixie Armco, which was at that time fabricating protective cans for shells. Next, a tour was made of the Bell Aircraft plant, including all departments from tool and fixture design to the final assembly of the B-29. A trip to Plant Atkinson, a 120,000-kw steam-power plant fired by either pulverized coal or natural gas, proved very interesting.

Speakers during the term included Mr. Floura of Allis-Chalmers Company, who gave a lecture on the gas turbine; Ernest Hartford, executive assistant secretary, A.S.M.E., who gave an excellent talk on the scope and undertakings of the A.S.M.E.; Dean Wilkinson, University of Louisville, who gave an interesting speech on the value of naval experience to the engineer who returns to civilian practice; and Prof. R. S. King, head of the mechanical-engineering department at Georgia Tech., who discussed the value and importance of being connected with professional societies.

The Branch initiated a movement for an "Engineers' Day" at Georgia Tech, this day to be set aside shortly after the opening of each new term; at that time all departments would be hosts to high-school seniors and Tech undergraduates so that they might learn what Georgia Tech has to offer, and become interested in the engineering societies.

Featured during the past term were reports on the history of Georgia Tech and the A.S.M.E. presented by members Freeman, Barnes, Lofflin, and Curtis. The branch has a membership of 41, the majority of whom are Navy V-12 students.

Iowa State College Branch

On May 30 a meeting was held in Engineering Hall, when C. T. Grace, faculty advisor, who has served the Branch faithfully for the last two years, presented his resignation. The speaker was Thomas S. McEwan, vice-president A.S.M.E., and vice-president of McClure, Hadden and Ortman, Inc., Chicago, Ill. His talk, entitled "Industry and Post-war Readjustment," gave the economic engineer's viewpoint of the future. A discussion followed.

University of Maine Branch

During the scholastic year 1944–1945 three meetings were held, two of which were combined with other engineering societies on the campus. Officers were elected at the November 30, 1944, meeting as follows: Kenneth E. Reed, president; Leonard R. Korobkin, vice-president; Roy C. MacGee, treasurer; and Helen Gorden, secretary.

A.S.M.E. UNIVERSITY OF MAINE BRANCH

(*Front row, left to right:* Helen Gorden, secretary, Prof. H. D. Watson, Kenneth E. Reed, chairman, Prof. I. H. Pragman, and Leonard R. Korobkin, vice-chairman. *Back row, left to right:* George Wallingford, Roger Hannemann, Thomas Plaisted, Wilfred Chesebrough, Roy C. MacGee, treasurer, Charles Carpenter, Joseph Waldstein and Ralph Peavey.)

On February 16, 1945, a meeting was held jointly with other engineering societies and sponsored by the Branch. Hartley Banton, an honorably discharged lieutenant of the antiaircraft division, spoke of his participation in the African and Sicilian campaigns. He is a 1941 graduate of the University of Maine in mechanical engineering and has returned for his master's degree.

The final meeting was held on May 2, in Lord Hall, with other technological societies on the campus. Allis-Chalmers movies "Steam Turbines," "Steam Condensers," and "Gas Turbines," were shown. A brief discussion period followed.

University of Maryland Branch

The final meeting of the spring quarter was held on June 19 as a joint meeting with the A.S.C.E., A.S.Ch.E., and A.I.E.E. Dr. L. A. Scipio gave an interesting talk on "Engineering Applications in Foreign Countries," with a graphic account of his early experiences in the establishment of Robert College in Istanbul, Turkey.

After the program new officers were elected as follows: A. Barnard Eyler, president; Benjamin Barish, vice-president; Edwin Eagelson, treasurer; and Benjamin Bochenek, secretary.

University of Michigan Branch

The last meeting of the spring semester was held on June 6 at Michigan Union, when Prof. E. T. Vincent of the mechanical-engineering department, spoke on "The Modern Diesel Engine." Professor Vincent explained the fundamental theory behind Diesel design and showed, with the aid of slides, the various approaches that have been used in the solution of these problems, concluding with a discussion of the future trends of Diesel design.

At the business meeting following the lecture Jay Johnson was elected president for the summer term; Don Vance, vice-president, and Nancy Alexander, secretary. Harold Walters was appointed engine council representative.

Ohio State University Branch

At the meeting on May 18 held in Robinson Laboratory, Mr. Mallett of Curtiss-Wright Company gave a talk on the difference between mechanical and aeronautical engineering and their fields in the plant.

The last meeting of the spring quarter was held on June 1. It was decided to postpone election of officers until the opening of the fall semester.

University of Pennsylvania Branch

The final meeting of the spring term was held on June 5 in the Engineering Building. A film entitled "Target for Today" was shown, prepared by the U. S. Eighth Air Force. A vote of appreciation was given to Serge Gratch, honorary chairman of the Branch. Officers elected for next term were: Robert Mostertz, chairman; William McCormick, vice-chairman; Rudolfo Gamboa, treasurer; Robert Bredin, secretary.

Purdue University Branch

The final meeting of the spring semester was held on June 6 when an inspection trip was made to the West Lafayette, Ind., Frozen Food Locker. Prof. H. G. Venemann, professor of refrigeration at Purdue University, conducted the tour and explained the mechanical equipment necessary in a plant of this type. He said that it was possible to maintain three different temperatures in the plant and yet require only one refrigeration machine. The business and economic phases were explained by the general manager of the plant, Mr. Ross,

A.S.M.E. STUDENT BRANCH, UNIVERSITY OF SOUTHERN CALIFORNIA

who also discussed the possible future of the frozen-food industry.

Rice Institute Branch

Comdr. Michael I. Kearns of the Brown Shipyard, Houston, Texas, gave a talk on steam auxiliaries and their use in the Navy, at the May 31 meeting. An open forum followed his talk, when he obligingly answered all questions concerning the advantages and prospects of naval engineering. At the business meeting which followed new officers were elected: Charles M. Smith, chairman; Gerald J. Shaw, vice-chairman; Calvin V. Dresser, secretary, and Marius J. Lucy, treasurer.

University of Southern California Branch

On April 18 in the Cinema Building, a recent release of a motion picture entitled "Hydraulic Forming Methods" was shown. A very interesting field trip was made to the Universal Engineering Company on May 18, in the company of Professor Woo. The company makes oil-drilling tools and the various processes of forming and shaping these tools were shown. The Branch won the championship of the volley-ball league from the undefeated industrial engineers on June 8.

Elections were held at the June 6 meeting in the engineering building, with the following results: John R. Nash, president; Frank O'Brien, vice-president; John W. Bonquet, secretary.

Swarthmore College Branch

The final meeting of the semester was held June 6 in the Engineering Building. A citation of merit from the A.S.M.E. was presented to John Kelly, president of the Branch, by Mark Moore, faculty advisor, with a statement of the services rendered by Mr. Kelly during the last year. The speaker was C. G. Thatcher, formerly head of the engineering department at Swarthmore and now newly appointed comptroller. From his recent experience working as an instructor of instructors in the shipyards at Wilmington, Del., Mr. Thatcher told of the method used to train foremen for their task of leading other workers.

Election of officers followed: John Easter, president; Donald Shelby, vice-president; Robert Gage, secretary-treasurer.

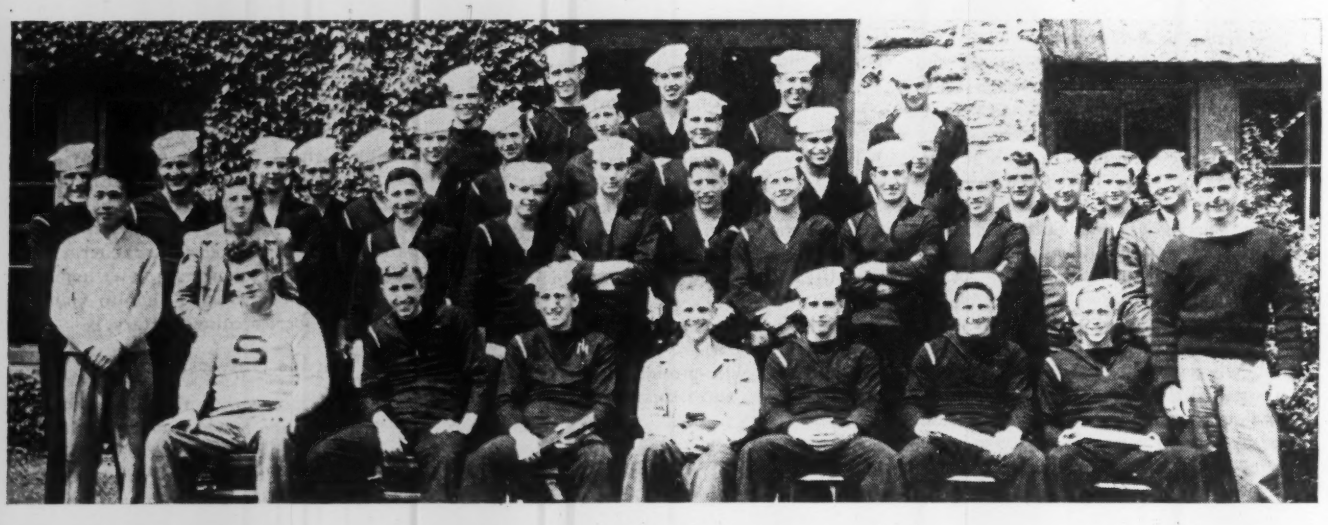
Villanova College Branch

At the meeting on April 12 a 30-minute film on lubrication was shown, and at the April 26 meeting a film entitled "The Story of a Spark Plug" was the feature.

Officers for the coming semester were nominated at the May 24 meeting. John Millet, chairman of the Branch, was presented with a certificate of award for outstanding effort and accomplishment.

Worcester Polytechnic Institute Branch

At the meeting of June 12 at Higgins Laboratories, new officers for the coming year were elected: Harold L. Schimmack, president; Robert N. Hamilton, vice-president; Albert E. Rockwood, Jr., secretary-treasurer.



A.S.M.E. STUDENT BRANCH AT SWARTHMORE

(*First row, left to right:* Warren Uchimoto, Jenks, J. D. Hammond, Christopher Branda, Jr., G. B. Mayfield, Schmittle, H. E. McCloskey, Neil Gilmour, Jr., Scott. *Second row, left to right:* Lisbeth Crowell, Bruno Mussetto, C. I. Crawford, Obbriet, J. H. Easter, Gage, D. W. Skilley, A. H. Albertson, Jr., G. B. Thom, Mark Moore, The latter two faculty advisors. *Third row, left to right:* Auer, B. J. Avery, J. F. Bushnell, J. W. Kelly, Sandt, D. H. Brown, I. F. Fausch, Jr., W. A. Runck, J. R. Picktelberger, J. A. Ward, Jr., Best. *Fourth row, left ro right:* E. C. Riock, K. E. Kranter, W. T. Brodie, R. F. Winch, Barrowes, Wenner, Kraig.)

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., which is under the joint management of the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to members and is operated on a co-operative, nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient, nonprofit personnel service and are available upon request. This also applies to registrants whose notices are placed in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available to members of the co-operating societies at a subscription of $3 per quarter or $10 per annum, payable in advance.

New York	Boston, Mass.	Chicago	Detroit	San Francisco
8 West 40th St.	4 Park St.	212 West Wacker Drive	109 Farnsworth Ave	57 Post Street

MEN AVAILABLE [1]

PROJECT OR PLANT ENGINEER, twenty-five years' mechanical and electrical engineering experience. Design-construction-maintenance. Qualified and experienced in directing engineering organizations. Desires position with manufacturer or electric utility. Me-917.

GRADUATE MECHANICAL ENGINEER, 30, five years' field and design experience in steam turbines and heat-transfer equipments, seeks position with progressive organization in chemical industry, consulting or power generating. Proficient in thermodynamics, mathematics, and applied mechanics. Me-918.

GRADUATE MECHANICAL (INDUSTRIAL) ENGINEER, registered professional, 34, married, ten years' experience in plant construction and manufacturing, knowledge of processing equipment, buildings, and piping. Desires position as Industrial Engineer, South preferred. Me-919.

PLANT ENGINEER, graduate mechanical, sixteen years' experience in covering chiefly plant engineering, supervising installation and maintenance of wide variety of plant equipment. Desires position as plant engineer with postwar future. Me-920.

GRADUATE MECHANICAL ENGINEER, 41, married, broad experience, design, development, application, and sales promotion of plastics, electric motors, controllers, marking dies, machines. Desires responsible position as project, liaison, or sales engineer. Me-921.

GRADUATE ENGINEER, licensed professional, 35, married, thirteen years' diversified experience in steam power and allied fields. Available about September for teaching or research in recognized university. Me-922.

MECHANICAL, INDUSTRIAL, AND CIVIL ENGINEER EXECUTIVE, 40, Army Officer, for 18 years consulting and executive experience in management, sales, plant layout, construction, production methods. Desires position abroad, preferably Latin America. Me-923.

POSITIONS AVAILABLE

MECHANICAL ENGINEER, 35–45 preferred, technical education, capable developing and designing new machines from ideas suggested; also advise and instruct mechanics on major repair jobs and alterations. Experience both in shop and drafting room on heavy machinery desired. Salary open. New England. W-5450.

MECHANICAL ENGINEER, graduate, 30–45, to select, specify, and engineer installation of, and make layouts for, fiberboard equipment and machinery. Engineer and design simple production machines and make paper-mill process piping layouts. Some paper-mill experience desirable. Salary, $3000–$4000 year, plus 20 per cent for overtime. Virginia. W-5545.

TOOL BUYER. One of largest screw machine products manufacturers in East is seeking services of tool buyer who has had heavy experience in this line. Must know sources and be thoroughly familiar with war surplus disposal procedures. Salary, about $5200 year. New York metropolitan area. W-5553-D.

DEVELOPMENT ENGINEERS, 33–38, Mechanical engineering graduate preferred, with considerable experience in both light and heavy machinery such as machine tools and calenders. Knowledge of hydraulics and heat exchange desirable, to design and develop machinery and devices; layout and detail major parts; and do considerable experimental work with some stress analysis. Salary, $4200–$5400 year. New Jersey. W-5567.

DEVELOPMENT ENGINEER, mechanical graduate, with some design and plant engineering experience, to improve and develop weaving machinery for textile manufacturer. Salary, $6000 year. Eastern Pennsylvania. W-5571.

METHODS ENGINEERS, 25–40, to co-ordinate methods, standards, and procedures in three plants. Some experience in printing industry desirable. Salary, $6000 year plus bonus. Probable location, California. Interviews, New York, N. Y. W-5576.

ENGINEERS. (*a*) Executive engineer to head up technical consulting bureau handling number of foreign engineering commissions. Should have good background of manufacturing, business, and financial experience. Washington, D. C. (*b*) Executive engineer, to head up engineering commission in South America, make surveys of natural resources, markets, and labor. Knowledge of Spanish desirable. Salaries, (*a*) and (*b*), $7500–$10,000 a year. (*c*) Geologists, 2. One preferably experienced in mining and the other in petroleum for South American work. Salary, $5600 year. W-5577.

TOOLROOM SUPERINTENDENT, 40–50, graduate mechanical engineer or equivalent, to supervise large modern toolroom; should have mechanical-engineering background and minimum of ten years' diversified practical experience in manufacture of small precision dies and tools. Work includes planning and co-ordination of various departments, and personnel administration. Must have had contact with various phases of mass-production manufacture of metal articles. Postwar opportunity. Salary, from $7000 year. Northern New Jersey. W-5588.

RESEARCH ENGINEER, under 40, graduate mechanical, to head up research division for lathe manufacturer. Broad experience in general machine work desirable. Salary, $5000–$6000 year. Ohio. W-5595-D.

SALES DIRECTOR, under 50, familiar with gas-combustion equipment for industrial use, to direct national sales agency's distribution to industrial users and public utilities. Also supervise revamping of advertising program. Salary, $10,000–$12,000 year. Headquarters in East. W-5596.

PLANT MANAGER, to 50, take complete charge of all operations except sales, advertising, and product design for sporting goods manufacturing concern working in wood, metal, leather, cork, paper, and plastics. Salary, $12,000–$15,000 year. New York State. W-5602.

PRODUCTION ENGINEER, 30–35, experienced in estimating, costing, time study, and standard costs. Experience in pulp and paper industry desirable. Must have ability to approve methods, unearth waste, and suggest economies. Salary, $5000–$6000 year. New York State. W-5603.

CHIEF PLANT MANAGER, 45–53, mechanical graduate, to make recommendations regarding new equipment, either standard make or special design, where such installations can be justified on basis of lower manufacturing cost or improved quality. Will direct its development, design, and manufacture; this is a prerequisite. Will be responsible for maintenance of plant and equipment, machine shop, and tool and die-making department. Salary open. New York, N. Y. W-5613.

DESIGN AND DEVELOPMENT ENGINEER, top-flight man, on small machinery and tool design. Will work on development of variations on existing small precision machinery, special machinery, etc. Salary open. Permanent. New York metropolitan area. W-5619 (a).

METHODS SUPERVISOR, about 50, who has served machine-shop and toolroom apprenticeship, done tool engineering, and has general methods experience. Salary, $7000 year. New York, N. Y. W-5623.

PLANT MANAGER with sugar-mill or similar process experience to take charge of citrus dehydration plant. Salary, $8000–$10,000 year. Texas. W-5638.

MECHANICAL ENGINEERS, graduates. (*a*) Manager of engineering with at least fifteen years' practical and administrative engineer, ing experience with products, such as resistance-welding machines, fixtures, accessories-heavy industrial machinery and equipment

[1] All men listed hold some form of A.S.M.E. membership.

for processing of steel products from raw stock to finished goods. Salary, $12,000–$15,000 year. (*b*) Chief Engineer, top-flight, with broad experience in design of industrial machinery and having at least ten years' experience in design work and direction of engineering personnel. Salary, $8000–$12,000 year. (*c*) Division Chief Engineers possessing top-flight design and administrative ability. Salary, $6000–$8000 year. (*d*) Project Engineers with excellent creative and design ability commensurate with execution development and design project. Salary, $4000–$6000 year. (*e*) Machine designers, young, having machine-design experience and capable producing final designs from sales drawings and sketches ready for detailing. Salary, $3000–$6000 year. Ohio. W-5645.

CHIEF INDUSTRIAL ENGINEER to supervise salary and job evaluation, standard costs, wage incentives, plant layout, production control, estimating, tool designing, and procedure manuals for concern of approximately 500 people. Salary, $6000–$7200 year. Ohio. W-5655-D.

DEVELOPMENT ENGINEER, under 35, proficient in gear design and also adaptable to development of material-handling equipment and power transmission equipment in general. Salary open. Pennsylvania. W-5653.

MANAGEMENT ENGINEERS, 2, 35–50, with considerable experience in time study, production control, job evaluation, etc. One should have some experience in steel fabrication or shipyards, and the other with textile-mill experience. Must be free to travel. Salary $6000–$6600 year. New England. W-5685.

Candidates for Membership and Transfer in the A.S.M.E.

THE application of each of the candidates listed below is to be voted on after August 25, 1945, provided no objection thereto is made before that date, and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

Re = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

For Member, Associate, or Junior

ALDAG, ROBERT, JR., Chicago, Ill.
ALTENEDER, THEO. G., Philadelphia, Pa.
ASHWOOD, LOREN F., Moline, Ill.
BABCOCK, HUGH H., Charlotte, N. C.
BARNES, JAMES F., Philadelphia, Pa.
BOELHOWER, NICHOLAS J., JR., Perth Amboy, N. J.
BUCKLEY, RAYMOND, Glens Falls, N. Y.
BURDOIN, ALLEN J., Boston, Mass.
BUSHMAN, A. K., Schenectady, N. Y.
BUTZOW, ELMER H., Evanston, Ill.
CALABRETTA, PETER, Brooklyn, N. Y.
CARACO, I. R., Los Angeles, Calif.
CARLSON, H. MAURICE, Columbus, Ohio
CARTER, JOSEPH COLEMAN, New York, N. Y.
CHOW, MING CHENG, New York, N. Y. (Rt)
CLUTZ, CLAUDE S., Radburn, N. J.
COOPER, CHARLES D., Columbus, Ohio
CROCKER, G.H. (COMMANDER), South Charleston, W. Va.
DE FERRANTI, MARC, Orchard Park, N. Y.
FINN, GEORGE A., JR. (LIEUT.), Cos Cob, Conn.
FISHER, HAROLD WALLING, Schenectady, N. Y.
FORREST, J. D., Vancouver, B. C.
FRANKEL, NATHAN A., JR., Chicago, Ill.
FRANKHOUSER, ELMER V., Upper Darby, Pa.
GALLIVAN, JOHN D., Balboa, C. Z.
GAMMELL, JOHN, Philadelphia, Pa.
GETZ, H. E., JR., Dallas, Texas
GILL, E. F., Surbiton, Surrey, England
HAACKER, CARL W., Trenton, N. J.
HAYS, FRED N., Pittsburgh, Pa. (Rt)
HAWLEY, CHARLES D., Ferndale, Mich.
HESS, WALTER JOHN, JR. (ENSIGN), San Francisco, Calif.
HILERA, PEDRO, New York, N. Y.
HINTON, CHARLES L., JR., Bronxville, N. Y. (Rt & T)
IRWIN, RUSSELL DOUGLASS, Oreland, Pa.
JELLEME, W. O., Short Hills, N. J.
JOHN, CARL F., Milwaukee, Wis.
JOHNSON, JOSEPH EDWARD, New York, N. Y.
KRYGIER, JOHN W., Detroit, Mich.
LEE, Y. C., Chungking, China
LEIGH, RICHARD SHIPMAN, Waterbury, Conn. (Rt &T)
LOEBEL, FRED A., Milwaukee, Wis.
LYON, ALAN G. (CAPTAIN), Paisley, Scotland
MOSBROOK, J. S., Wilmington, Del. (Rt)
MOSES, WILLIAM G., Birmingham, Ala.
MUSIK, ANTHONY, Lynn, Mass.
NATHANSON, M., Montreal, Quebec
NOVACK, EDWARD J., Mineola, N. Y.
OKSEN, ROBERT E., Upper Montclair, N. J.
PARISH, J. M., JR., Freeport, Texas
PATTERSON, ROBERT C., New York, N. Y.
PEARSON, W. H., Upper Darby, Pa.
PENN, ALFRED D. (LIEUT.), New York, N. Y.
PETERSON, EDGAR W., Moline, Ill.
PINDER, H. C., Toronto, Ont.
PLOURDE, EUGENE W., Lynn, Mass.
POLLARD, F. W., Los Angeles, Calif.
POPE, HOWARD L., Cincinnati, Ohio (Rt & T)
QUAID, JAMES A., Merion, Pa.
ROBINSON, H. DELMER, JR., Winchester, Va.
SHELLY, L. W., Allentown, Pa.
SPAULDING, DAVID C., JR., Toledo, Ohio
STEVENS, HERBERT, JR., New York, N. Y.
TEASLEY, GLADSTONE I., Knoxville, Tenn.
TEICHMANN, O. E., Chicago, Ill.
TOMITA, ARTHUR K., Chicago, Ill.
TRUE, M. AUSTIN, St. Louis, Mo.
VICKERY, J. EDW., JR., Trenton, N. J.
WALKER, GLEN H., Seattle, Wash.
WANZER, ARTHUR W., North Quincy, Mass.
WARNEKE, MAYNARD J., East Pittsburgh, Pa.
WEBER, PAUL R., Charleston, W. Va.
WILLIS, P. T., San Francisco, Calif.
WOOD, ARTHUR L., Oldham, Lancashire, England

CHANGE OF GRADING

Transfers to Fellow

BOWERMAN, MYRON RALPH, Homeworth, Ohio
CLARK, WALLACE, New York, N. Y.
KARLSSON, HILMER, Wellsville, N. Y.

Transfers to Member

BOYLE, JOSEPH C., Washington, D. C.
ERHARDT, WALTER LOUIS (MAJOR), Fort Belvoir, Va.
HARRIS, CHARLES O., Chicago, Ill.
SPRINGER, EDWIN KENT, Madison, Wis.
STROTHMAN, E. P., Barrington, Ill.

Transfers from Student Member to Junior 18

A.S.M.E. Transactions for July, 1945

THE July, 1945, issue of the Transactions of the A.S.M.E. contains:

Silica Deposition in Steam Turbines, by F. G. Straub and H. A. Grabowski
History of Potassium Boiler-Water Treatment at Springdale, by L. E. Hankison and M. D. Baker
Experience With Potassium Treatment at Windsor Station, by W. L. Webb
Embrittlement Cracking in Waters Containing Potassium Salts, by A. A. Berk and N. E. Rogers
Experience With Sodium and Potassium Chemicals for Boiler-Water Conditioning at Montaup Electric, by G. U. Parks
The Coefficient of Herschel Type Cast-Iron Venturi Meters, by W. S. Pardoe
Piping Arrangements for Acceptable Flowmeter Accuracy, by R. E. Sprenkle
Water-Hammer Analysis by the Laplace-Mellin Transformation, by G. R. Rich
Water-Hammer Problems in Connection With the Design of Hydroelectric Plants, by E. B. Strowger
Electronic-Type Instruments for Industrial Processes, by P. S. Dickey and A. J. Hornfeck
An Instrument for Indicating the Amount of Gas in Gas-Liquid Mixtures, by B. R. Walsh and G. S. Peterson

Necrology

THE deaths of the following members have recently been reported to headquarters:

BARNES, HAROLD H., June 25, 1945
BROWN, HARRY C., February 21, 1945
DOUGHERTY, CHARLES J., June 18, 1945
DOWDING, LEONARD E., April 9, 1945
FELLOWS, EDWIN R., May 21, 1945
KLAUDER, LOUIS T., May 26, 1945
LARSON, PAUL O., March 19, 1945*
PRICE, HENRY M., May 3, 1945
ROWAND, ELLWOOD M., JR., February, 1945
SIBOLE, BARTON P., June 6, 1945
TRAGER, LEON, June 19, 1945
WATSON, THOMAS A., April 22, 1945
WHITTIER, CHARLES R., June 5, 1945

* Died in line of duty.

• Keep Informed . . .

Announcements in this section are supplied by current advertisers in MECHANICAL ENGINEERING and A.S.M.E. MECHANICAL CATALOG.

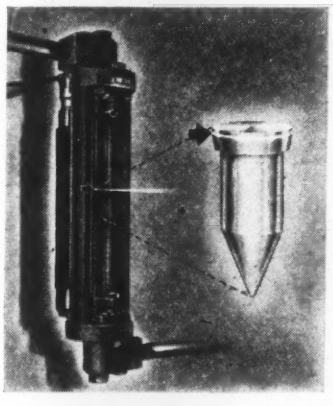
This section is restricted to these advertisers.

• NEW EQUIPMENT
• BUSINESS CHANGES
• LATEST CATALOGS

Available literature may be secured by addressing a request to the Advertising Department of MECHANICAL ENGINEERING or by writing direct to the manufacturer and mentioning MECHANICAL ENGINEERING as a source.

• NEW EQUIPMENT

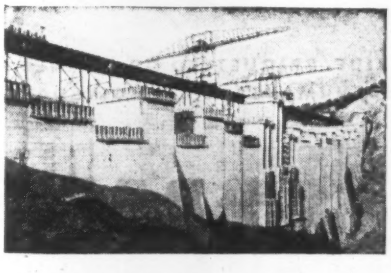
New Line-o-Light Rotor For Any Rotameter



For sharp, clear Rotameter readings of opaque liquids, the new patented Schutte & Koerting Line-o-Light rotor is especially well suited. This rotor, having the same basic design as a standard SK rotor, has a disc of light-transmitting material sandwiched in the rotor head which substantially reduces the distance that the light must travel through the opaque liquid from its source behind the tube. Rate-of-flow is thus delineated sharply in the resultant band of light on the tube reference scale and operators can make easy, accurate readings.

This Line-o-Light rotor can be used for practically any application and in any type tapered glass tube rotameter. Two types of discs can be furnished: Lucite for general applications and Pyrex glass for extremely hot or highly corrosive fluids.

New Maxspeed Hoist Drive Announced by General Electric



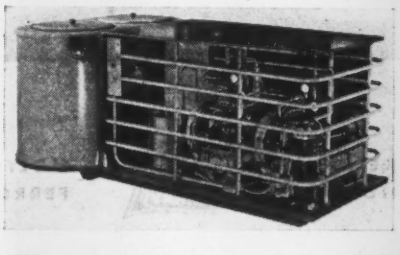
A new hoist drive for cranes, known as the Maxspeed system, has been announced by the Industrial Engineering Division of the General Electric Co. The new drive, which automatically "measures" the load so that it is hoisted and lowered at the maximum safe speed yet prevents the handling of dangerous overloads, is designed for use on either indoor overhead, slow-speed cranes, or high-speed cranes of the type used in outdoor construction. The drive is particularly desirable for use on these cranes where accurate hoisting and lowering operation is of utmost importance.

The drive operates from either a-c or d-c incoming power. If used with a-c, the drive consists of a generator, an unusually constructed cross-flux exciter, an ordinary constant-voltage exciter—all driven by an induction motor, and a d-c hoist motor similar to the type used in crane-hoist installations except that its main field is designed for a variable separate excitation. If used with d-c, a shunt-wound d-c motor drives the generator and cross-flux exciter instead of an induction motor, and the constant-voltage exciter may be eliminated. Regardless of the type of power used, it is the special construction of the cross-flux exciter and the way in which it is connected to the other components of the drive that produces the unusual characteristics.

In operation, heavy loads are both hoisted and lowered at slow speeds, and light loads or the empty hook are hoisted and lowered at high speeds. Intermediate loads are handled at intermediate speeds, depending on the weight of the load. These speed changes are inherent in the drive and do not depend on the functioning of the control devices. All braking is accomplished electrically, the power being returned to the supply system instead of being dissipated in resistors. A solenoid brake holds the load when at rest.

New "Deepfreeze" Cascade Unit

The "Deepfreeze" Division of Motor Products Corporation, pioneer builders of extreme low temperature chilling machines, has recently announced a new model to add to their fast growing line.



This new model, known as the 4G15-2 "Deepfreeze" Cascade Unit, is particularly designed for heavy duty work. The construction is unusually rugged, even to the table top, which is made of specially treated plywood and is capable of bearing extremely heavy weights.

The refrigeration unit consists of two General Electric water-cooled compressors, each operated by a 2 h.p., 440 volt, 60 cycles, 3 phase motor.

The thermal capacity is 4000 BTU's per hour at —120°F when used with a convection liquid. Fourteen pounds of steel can be chilled from plus 80°F (room temperature) to minus 120°F in any 8-hour day.

The chilling chambers, of which there are two, have a capacity of 56 gallons, or 7.5 cubic feet each, and are equipped with thermostatic controls making it possible to maintain different temperatures in either cylinder within the range of minus 80°F and minus 120°F.

For complete details and prices on this equipment, write Motor Products Corp., Deepfreeze Division, 2301 Davis Street, North Chicago, Ill.

Roots-Connersville "Turtle Back" Blowers

Pictured above are two Roots-Connersville Blowers built a long way apart. The young lady has her right hand on an early type, known as the "turtle back," which was built about 1875. To her left is a current model driven by a light-weight gas engine, this unit having been developed for the Army Air Forces for use in field service to salvage crashed planes. The unit is readily portable and is used to inflate large bags, or "pillows," which serve as pneumatic jacks in salvaging operations. Roots-Connersville Blower Corp. of Connersville, Ind., has been engaged practically 100% in war work since early 1942, and was making supercharging blowers for Navy Diesel engines as early as 1939.

An Adjustable-Range Force-Measuring Spring

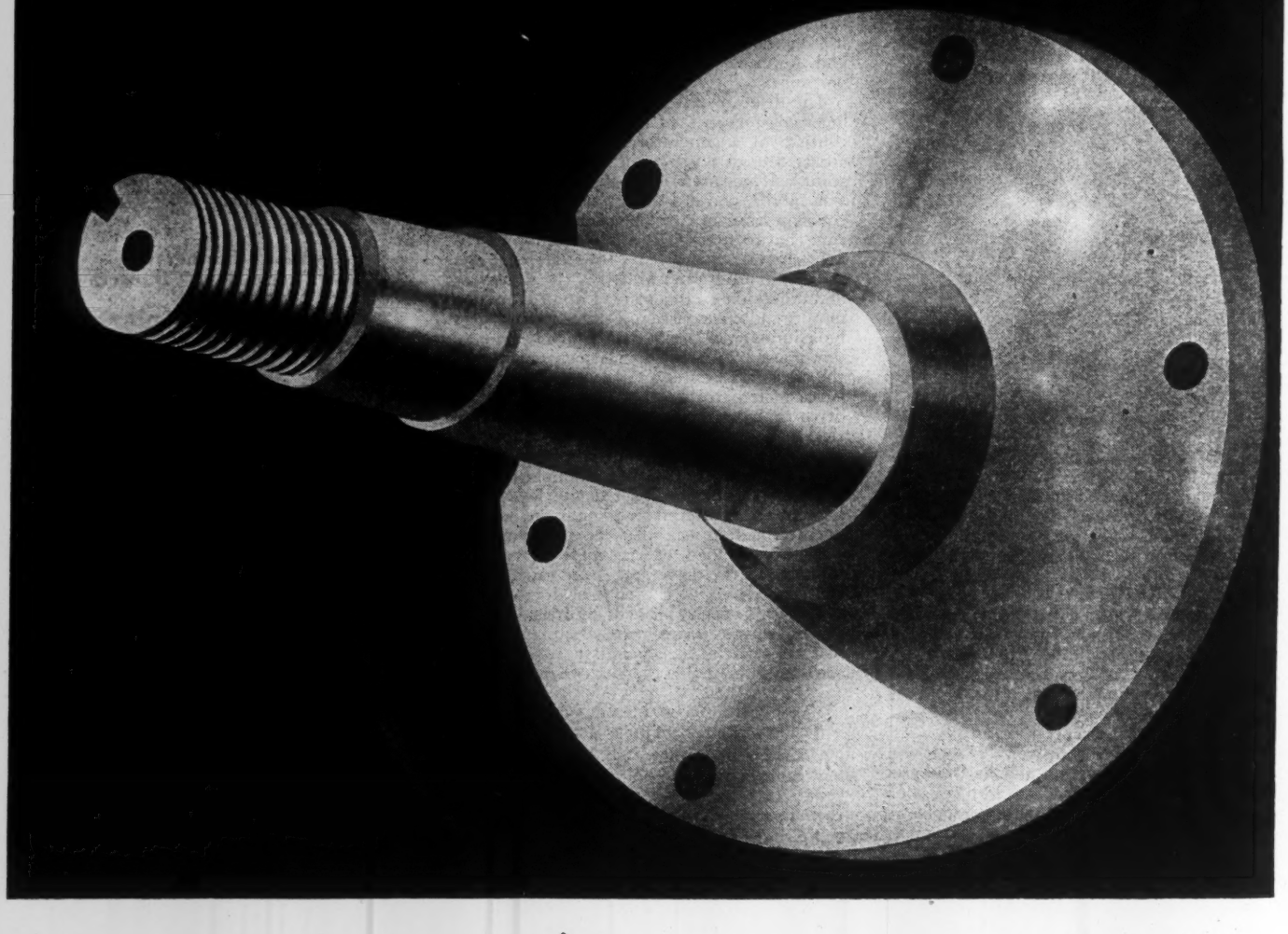
A new type force-measuring beam provides comparable deflections under such widely divergent load ranges as 0 to 4,000 pounds, 0 to 20,000 pounds, and the maximum, 0 to 100,000 pounds.

Developed by M. J. Manjoine of the Westinghouse Research Laboratories, this new measuring beam has a stiffness which can be varied in accordance with the desired load range.

In most testing machines it is necessary to change the force measuring system when

Continued on Page 29

Molybdenum is an economical preventive of temper brittleness in steel.



CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

ARMY E NAVY

MOLYBDIC OXIDE, BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Molybdenum Company

500 Fifth Avenue • New York City

MOLY

testing materials requiring widely varying loads. If the usual force measuring spring is made with sufficient strength and stiffness to withstand maximum loads of perhaps 40,000 to 50,000 pounds, it is so designed that the deflection under such loads is substantial and easily measured with a suitable extensometer. For light loads the deflection of such a spring is obviously smaller. For a 4,000 pound load, the ratio of movement to that of maximum loading is as high as 12.5 to 1 with corresponding decrease in measurement accuracy.

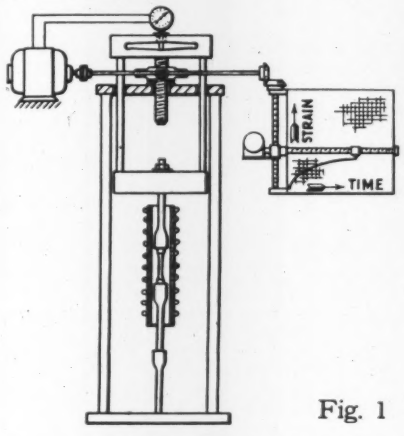


Fig. 1

One conventional type of equipment used in testing materials in tension is shown in Figure 1. The screw-jack exerts a force on the bottom of the slotted force-measuring bar. An extensometer is mounted on the top of the bar. The extensometer probe extends down through a vertical hole drilled in the bar and rests against the top of the lower section. Any change in the force exerted against this lower section by the screw-jack moves this probe and the change is registered on the extensometer.

When the necessary force is applied by the motor-driven screw-jack, the force-measuring spring is deflected a certain distance. Contacts in the extensometer, through electrical controls, limit this deflection (hence the applied force) by stopping the drive motor. When the material under test elongates to such an extent that the deflection of the weighing bar drops below a preset figure, electrical contacts again activate the motor-starter control and re-establish the original force on the bar. Thus a constant force is maintained on the beam and a constant load on the specimen material. This force-measuring spring or weighing bar is shown in Figure 2 in more detail.

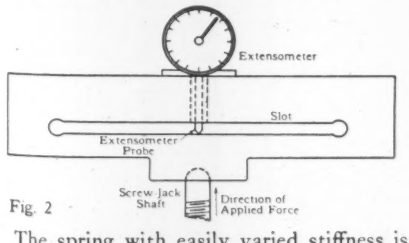
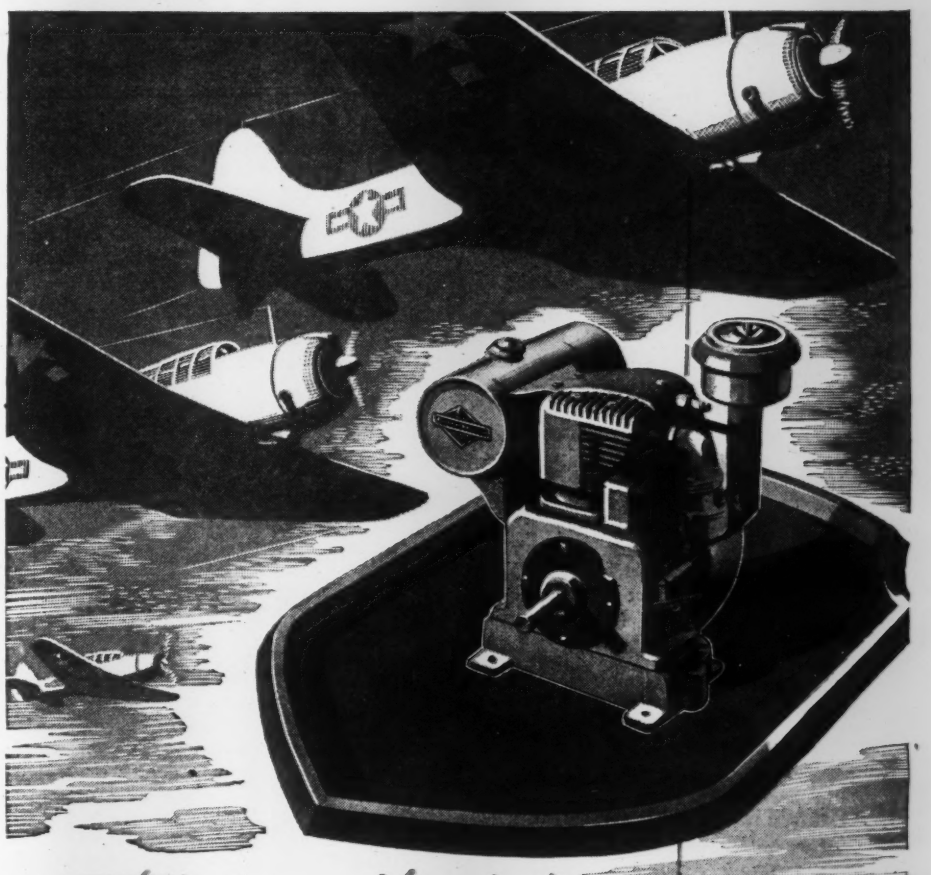


Fig. 2

The spring with easily varied stiffness is shown in Figure 3. It is made similar to the one shown in Figure 2, except that there are three slots instead of one. In the center of two slots transverse holes have been drilled. The lower slot is long and relatively close to the bottom of the beam. This is the most easily deflected portion of the bar. Should the force involved exceed the resistance of this section, short steel pins can be inserted into the drilled-out places in the center of the

Continued on Page 30



Flying High!

AIRCRAFT ENGINES KEPT PURRING WITH *CLEAN* OIL

To keep fighters and bombers flying from far-flung bases the world over, the lubricating oil for aircraft engines is kept clean by frequent filtering with portable units powered by gasoline engines. One more of many standard and special applications for Briggs & Stratton 4-cycle *air-cooled* gasoline engines.

Everywhere they continue to establish new performance records—adding to their reputation as the world's finest small air-cooled engines—forcasting greater utility than ever before on a steadily increasing number of gasoline-powered appliances and equipment.

Air-Cooled Power

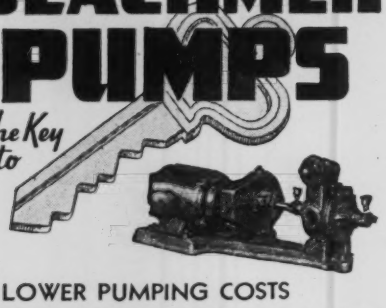
4 CYCLE BRIGGS & STRATTON GASOLINE ENGINES

Briggs & Stratton leadership in design, engineering and precision manufacture is the result of a quarter-century of *continuous* production of *"air-cooled power."* Manufacturers and users of all types of equipment requiring dependable, compact gasoline powered units will find it profitable to call for this experience to help them solve their power problems.

BRIGGS & STRATTON CORPORATION, Milwaukee 1, Wis., U.S.A.

BLACKMER PUMPS

The Key to



- LOWER PUMPING COSTS
- SUSTAINED PUMPING CAPACITY
- PUMP DEPENDABILITY

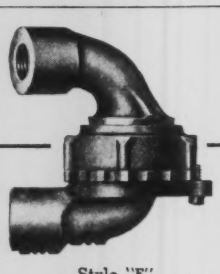
Write for Bulletin No. 306— FACTS ABOUT ROTARY PUMPS which explains why the "Bucket Design" (swinging vane principle) maintains pumping capacity by automatically compensating for wear and how the buckets, when finally worn out, are easily replaced and the pump restored to its normal capacity.

BLACKMER PUMP COMPANY

1920 Century Ave. Grand Rapids 9, Michigan

Capacities to 750 GPM. Pressures to 500 psi.

POWER PUMPS · HAND PUMPS · EZY-KLEEN STRAINERS ·



Style "F" Double Angle Return Bend

FLEXO JOINTS

MAKE PIPE FLEXIBLE WITH THE SAFETY OF RIGID FITTINGS

FLEXO JOINTS are safe and efficient and are made for all pressures up to 1350 lbs. superheated steam. They maintain the alignment of piping and are ruggedly constructed to outlast the pipe to which attached. No springs, ground surfaces or delicate parts are embodied in their construction. All moving parts are entirely enclosed and fully protected from dirt and grit.

FLEXO JOINTS are used for handling steam, compressed air, water, oil or other fluids through pipe lines that must be moved or swung in different directions or to supply machinery or equipment with any fluid while in motion. For every flexible or swing pipe joint service—use **FLEXO JOINTS;** your regular supply house has them.

4 styles—pipe sizes to 3 inches.

WRITE FOR BULLETIN

FLEXO SUPPLY COMPANY, Inc.

4219 Olive Str. St. Louis (8), Mo.

In Canada

S. A. ARMSTRONG LTD.

115 Dupont Str. Toronto (5), Ont.

slot. (Because the extensometer probe extends from the top of the spring through a vertical hole in the center, the steel pins cannot extend entirely through the thickness of the spring. A short pin is placed in the drilled-out portion of the slot from each side thus avoiding interference with the extensometer probe.) Thus the lower section is firmly coupled to the middle section and utilizes the stiffness of both. Should additional stiffness be required, pins inserted in the hole in the second slot causes the force to be opposed by three sections of the beam thus providing a maximum of stiffness.

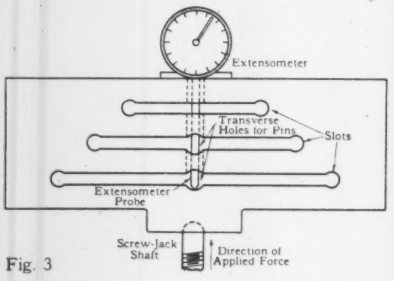


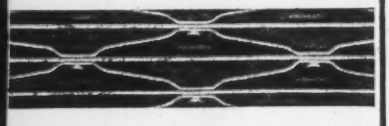
Fig. 3

With the new weighing bar it is possible to run tests on such widely dissimilar materials as steel, copper, porcelain and plastics and secure in each class the same degree of accuracy in measuring the stresses involved. By matching the stiffness of the beam to the forces required by the different tests, approximately the same degree of deflection is secured in each case and the accuracy of the results are comparable. With the usual single-slot bar, the disparity in deflection under loads of 4000 and 100,000 pounds per square inch is a measure of the difference in accuracy and ease of control.

IRVING GRATING

FLOORING AND STAIR TREADS

"A Fitting Grating for Every Purpose"

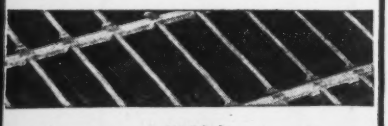


Riveted

Walkways — Stair Steps — Platforms
Trucking Aisles — Trench Covers

Press-Locked

Industrial Plants — Oil Refineries
Chemical Plants — Power Houses
Naval and Merchant Ships
Locomotive, Passenger and Freight Cars



Welded

Catalog for the asking.

IRVING SUBWAY GRATING CO., INC.

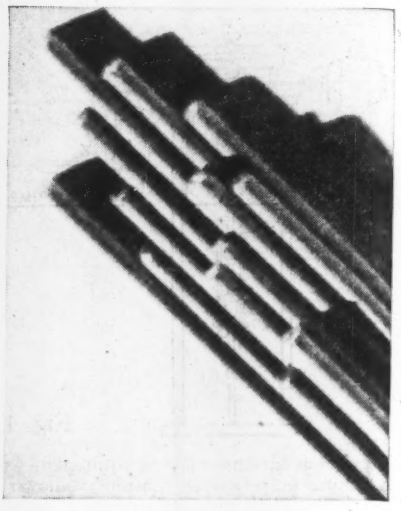
ESTABLISHED 1902

HOME OFFICE and PLANT: 5010 27th STREET LONG ISLAND CITY 1, NEW YORK

WESTERN DIVISION: FOOT OF PARK AVE. EMERYVILLE 8, CALIFORNIA

ACP Electrodes Announced by Westinghouse

For speedy and economical welding in all positions and with A-C and D-C reverse polarity, the new ACP electrode available in seven diameters form $^{5}/_{16}$" to $^{3}/_{32}$" is announced by the Westinghouse Electric Corp.



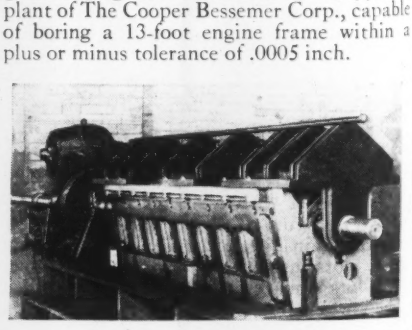
The new heavily coated electrode, recommended for high-quality welds on work which is not easily positioned, forms a light, porous slag which is easily removed from each pass by light brushing. Because of high tensile strength and ductility of welds made with ACP, this rod is especially suited for heavy plate fabrication, shipyard, pressure piping, pressure vessels, and general structural steel work.

Easy to handle on vertical and overhead work, ACP produces excellent results in making horizontal fillet welds and lap joints on all low and medium carbon steels, as well as low alloy and cast steels. It meets Navy specifications as well as various association code requirements.

Further information on the ACP electrode may be secured from P.O. Box 868, Westinghouse Electric Corp., Pittsburgh 30, Pa.

Cooper Bessemer Gets Greater Precision From New Giant Borer

A recent development in precision machining, the key to the versatility of American Diesel engines, was the installation of a giant boring bar in the Grove City, Pa., plant of The Cooper Bessemer Corp., capable of boring a 13-foot engine frame within a plus or minus tolerance of .0005 inch.



This giant boring bar, one of the largest in existence, has proven to be a potent factor in arresting vibration, reducing engine noise and generally prolonging the life and efficiency of the company's Diesel engines, which

• Keep Informed

now are being produced exclusively for the nation's Army, Navy and Maritime services and for war-critical industries.

Used in machining to precision tolerances the engine main bearing bores, this machine accomplishes one of the most difficult operations of Diesel construction. Accurate alignment throughout the entire length of the engine frame and extremely close tolerances of bore diameters are now manufacturing musts if performance demands of the government services are to be met.

Although a bar of any size can be used on the new giant borer, it is now doing a precision job on The Cooper Bessemer GSB engine which calls for a hole $8^1/_2$ inches in diameter through the 13-foot frame to a tolerance of plus or minus .0005 inch.

Prior to the introduction of this new borer most of this type of work was done on the milling machines using a special head. The engines completed by this former method were designed with the shim-type bearing and the tolerances which were accumulated were taken care of by the shims.

The use of shimmed bearings, Cooper Bessemer engineers point out, was the second step of a three-step development in Diesel engine manufacture. In the earlier days of the Diesel, bearings were fitted and scraped by hand. Then shims were used to take care of accumulated tolerances. Now shimless bearings are possible.

It is pointed out that the new boring machine was brought into use when a demand for still greater accuracy in machining was required and the new machine is accomplishing its purpose.

The new borer, because of its large size, operates only horizontally in boring on the larger engines. Separate bars are made for each engine and are clamped to the engine bed and driven by a floating drive.

The borer consists of two principal parts, the driving mechanism and the bar, together with the locating support which can be any size designated. It is operated by one man, whose ability to properly set up the bar is responsible to a great extent for the precision accomplished. At times a helper is employed to assist in setting up the larger jobs.

Cooper Bessemer engineers point out that this new method of obtaining precision boring greatly reduces the time and skill required for servicing the engines in the field, particularly in connection with the interchangeability of bearings, and it permits the carrying of higher loads which in turn reduces the overall size of the unit. It is largely responsible for the increased horsepower in automotive type engines which have been recent accomplishments.

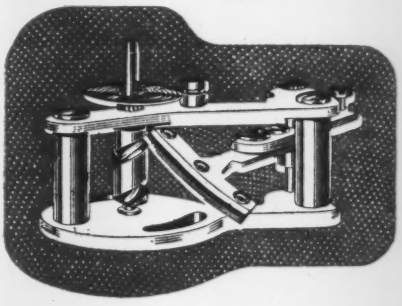
Carrier Air Conditioning Unit in Instrument Testing Laboratory

"The essence of instrument measuring practice is the ability to come back to a known and unquestioned standard which we could not do if there were any appreciable temperature variation." This statement by V. P. Cronin, Chief Engineer of the Sensitive Research Instrument Co., Mount Vernon, N. Y., explains in large measure why that company has installed a Carrier self-contained air conditioning unit in its instrument testing laboratory.

The Carrier equipment maintains the temperature at 70 degrees F., and relative humidity at 45 per cent. "This temperature is most important because electrical measuring instruments are used all over the world, which means that, when we ship an instrument, we do not know whether it is going to be used in the tropics or in the arctic. How-

Continued on Page 32

IT'S IN THE GROOVE!



The groove in the roller of the Helicoid movement has a helicoid surface. This surface is hard and polished. The Bakelite cam rides on this surface in continuous, rolling point contact. No metal spur gear teeth can compare with this combination in wear resistance, smoothness and accuracy.

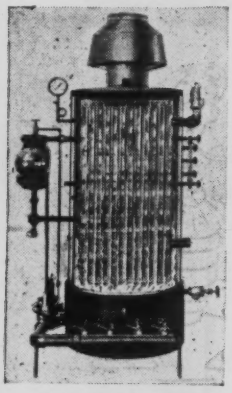
The principle of the helicoid is as old as Archimedes. But its use to translate and multiply linear motion into rotary motion in the same plane is new in the Helicoid movement. And the Helicoid movement is the first new, major improvement in pressure gauges since the Bourdon tube was invented.

Only Certified Pressure Gauges are made with the Helicoid movement. They are guaranteed to test-gauge accuracy. Yet, they will wear longer and remain accurate longer than any other pressure gauge made. They are ideal for engines, locomotives, turbines, tractors, hydraulic presses, pumps, and compressors.

See your nearest Distributor.

Certified GAUGE
AND INSTRUMENT CORP.

For Limited Floor Space



Scientifically designed to give maximum service to the user, the gas-fired, automatic, KANE steam boiler occupies only minimum floor space.

After the war when ordering boilers on new installations or for replacements, specify the KANE for trouble-free operation. Built in sizes up to 30 H. P., to A.S.M.E. Code, it generally can be placed right next to the equipment it serves.

Install KANE boilers for post war jobs. They will help solve your floor space problems.

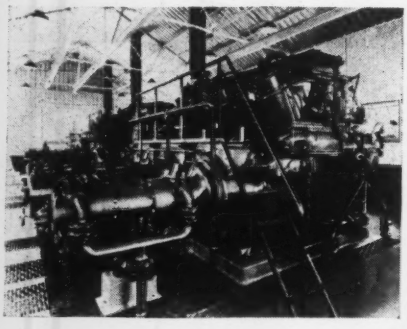
MEARS-KANE-OFELDT INC.
Manufacturers of Automatic Steam Boilers for over a third of a century.
1903-1915 EAST HAGERT STREET, PHILADELPHIA 25, PA.

• Keep Informed . . .

ever, it is imperative that the user of such instruments know the temperature at which the instrument was standardized. Then, by applying certain temperature correction formulas, the instrument can be used with the absolute assurance that it is reading correctly," Mr. Cronin said.

Exceptionally Low Cylinder Wear Marks Advances in Compressor Construction

Cylinder wear of approximately one-thousandth of an inch per 10,000 horsepower hours, about one-tenth the normal wear rate, has been reported on various GMV compressor installations by The Cooper-Bessemer Corp., Mount Vernon, Ohio, and Grove City, Pa.



Signifying the steady progress in the design and construction of the V-type compressor units, inspection reports from the company's files reveal one case where cylinder wear for the compressor installation at the Continental Oil Co., Benevides, Texas, had .003-inch cylinder wear after 23,000 hours of operation, or about .001-inch per 9,500 operating hours. This is almost ten times better than the normal wear rate.

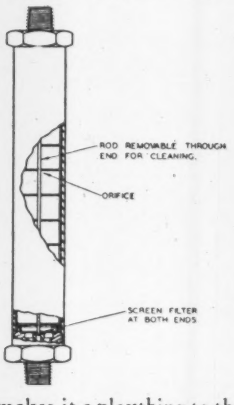
An installation at the Federal Glass Co. of Columbus, Ohio, showed only .001-inch of wear on the power cylinders after three years of operation.

Some of the principal developments which have contributed to this phenomenally low cylinder wear, according to engineering authorities of the manufacturer include the extensive use of Meehanite metal, an exceptionally close-grained iron alloy which gives extra strength and wear-resistance; extensive research which has brought about a considerable reduction in piston ring thickness, the narrower rings providing ample seal and causing less wear; and a piston design which permits effective, uniform heat dissipation.

There have also been numerous refinements in the fabrication and finishing of the cylinder components, including the use of the world's largest vertical honing machine which is designed to attain utmost precison in cylinder finishing.

New Pulsation Damping Unit Overcomes Difficulties Associated with Controlling of Pressure Waves

The measurement of pressure and flow can become quite difficult when changes occur in rhythmic fashion particularly so when they are of an oscillatory nature and possess amplitudes which are equal to or exceed 1% of full-scale range. Under such conditions, chart records and control settings may deviate considerably from the ideal. To effect the removal of pressure waves, various damping devices are available, and when analyzed, may be classed into two different types: the variable orifice and the fixed orifice; both of these devices are apt to offer difficulty. During the closing operation of the variable orifice, there is developed a pressure loss which causes the pressure instrument to indicate a value which is less than the true value. In the case of the fixed orifice type, such as a long tapered needle valve, or a length of capillary, the area of the orifice must be small. This feature becomes a decided disadvantage when it is considered that in most all industrial applications, minute solids are ever present which will quickly plug up the orifice. In addition, the adjustability of the device makes it a plaything to the inexperienced and such action could and has caused serious difficulties in the operation of related equipment. To overcome the difficulties associated with the variable orific type and the fixed orifice type, Taylor Instrument Cos. have developed a new and different type of pulsation damping unit. It is universal in application, non-adjustable and delivers an output pressure which is essentially equal to the average flow of the pulsating input pressure.



The Taylor Pulsating Damping Unit has no moving parts, nor is there need for any external adjustment to be made. It consists of a series of alternate small capacities or volumes and orifices. As the pressure wave enters the device, a differential occurs across the

ROD BABBITTING
Another Plant Controlled Operation on all
WISCONSIN Air-Cooled ENGINES

There's more to babbitting connecting rod bearings than simply applying the metal. Not only must the work be expertly done, but it is important that frequent detailed chemical analyses be made of materials in order to provide a dependable safeguard against inferior quality bearing metal, and to assure constant uniformity.

Wisconsin Engine connecting rod bearings are babbitted in our own plant, under our own complete control. A careful check is maintained to make sure that the metal is always what it *should* be and that it is applied *the way it should be*. This helps to make a better engine . . . designed to give better service on your equipment.

Most H.P. per pound
WISCONSIN MOTOR Corporation
MILWAUKEE 14, WISCONSIN, U. S. A.
World's Largest Builders of Heavy-Duty Air-Cooled Engines

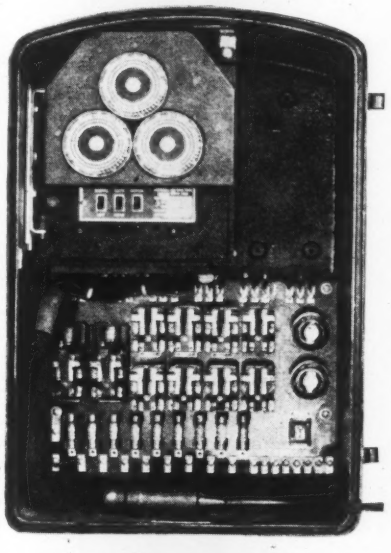
• Keep Informed

first orifice which causes a flow through it, thus raising the pressure in the adjacent chamber. This in turn causes a flow through the next orifice, producing similar effects except with decreased intensity. While this "above-average" value of the pressure wave is making its way through the series of chambers, the pressure drops below the average value (since it is a pulsating one) causing a reversal of the flow process. Thus it can be said that the various capacities "breathe" with decreasing intensity as the waves pass through the damping unit until finally a point is reached where the pressure level lies just about at its average value. It is important therefore that each individual orifice provide the same drop for the same flow, regardless of direction.

To overcome the difficulty of plugging, fine mesh screens are provided at both the entrance and exit of the damping unit. In addition, a rod which passes axially through the series of orifices can be readily removed, thus exposing a large orifice area for simple and effective cleaning. The device is completely free of gaskets and the caps are welded to the tubes to provide leak-proof construction. The unit is subjected to a static pressure test of 3,000 psi. and bears a working pressure rating of 1500 psi. Adapting the unit to liquid or gas service, is made by using one of the two rods supplied, the selection of which is made at time of installation.

For further information, write to Department B, Taylor Instrument Cos., Rochester, New York.

Multi-Dial Traffic Controller



A multi-dial traffic controller which permits automatic changing of signal-interval lengths to correspond with changes in the volume of main and cross-street intersecting traffic has been announced by the General Electric Lighting Division at Schenectady. The length of a pedestrian interval can also be changed to correspond with changes in pedestrian volume.

The controller, available with two or three dials, comes in two types, one for isolated intersections and the other for use with single- or other multi-dial controllers in an interconnected system. Each dial is preset for a different traffic condition. When the predetermined condition occurs, a time switch automatically brings the correct dial into operation. A manual switch on the controller panel can be used for operating any of the

Continued on Page 34

MAKE A TEST...

for transparency and surface qualities, and to prove perfection in the base fabric. No pinholes, weaver's marks or variations in density!

SET MIND AT REST...

about whether your drawings will blueprint clear and sharp in every detail . . . whether they'll defy time and handling. They will!

THERE'S JUST ONE "BEST"...

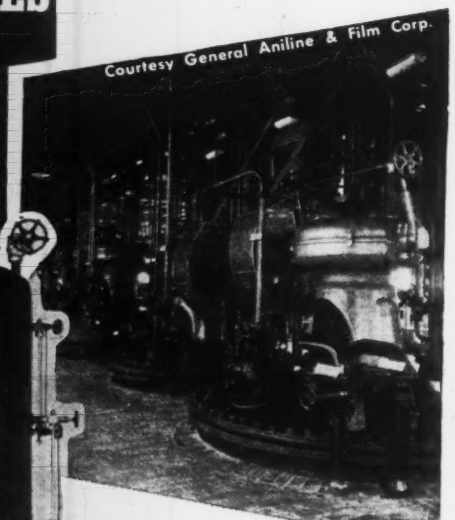
We put superior quality into Arkwright Tracing Cloths years ago. We've maintained uniformity in this superior quality ever since. Arkwright Finishing Company, Providence, Rhode Island.

Sold by leading drawing material dealers everywhere

Arkwright
TRACING CLOTHS
AMERICA'S STANDARD FOR OVER 20 YEARS

HAERING GLUCOSATES

and Haering
PROPORTIONING UNITS
assure correction
and control of
CORROSION, SCALE, ALGAE
in Industrial Plants



WRITE FOR
"H-O-H WATER
STUDIES"

WE
READ
WATER

D. W. HAERING & CO., Inc.
GENERAL OFFICES:
205 West Wacker Drive, Chicago 6, Ill.

AUTOMATIC CONTROL Saves You Fuel, Materials, Manpower

PRINCIPLES of INDUSTRIAL PROCESS CONTROL

By DONALD P. ECKMAN

Presents a thorough treatment of the theory of automatic control, based on actual operating experience, which co-ordinates in one convenient volume the basic principles necessary to handle the mechanisms employed in industrial instrumentation. It emphasizes theory rather than mechanics so that the engineer may apply general principles to his particular problems. Will prove an invaluable training manual in industrial plants where control measures are in use or are contemplated.

Includes the first comprehensive treatment of measuring characteristics of controllers, controller characteristics, the effect of process load changes, the effect of valve characteristics, correlated or multiple control systems. Features bibliography, glossary and definitions.

237 Pages Illustrated $3.50

---ON APPROVAL COUPON---

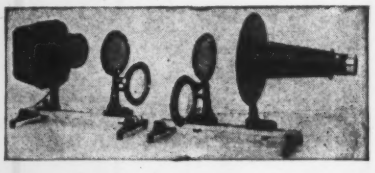
JOHN WILEY & SONS, INC.
440 Fourth Ave., New York 16, N. Y.

Please send me a copy of Eckman's INDUSTRIAL PROCESS CONTROL on ten days' approval. At the end of that time, if I decide to keep the book, I will remit $3.50 plus postage; otherwise I will return the book postpaid.

Name.....
Address.....
City and State.....
Employed by.....ME-8-45

Polaroid*...
Photoelastic Polariscope
for Stress Determination

For either qualitative or quantitative photo-elastic analysis, perfection in the projection lens system is of major importance.



In our new model polariscope of 4¼" clear aperture, the parallel beam is collected by a rear element and condensed through a three component lens of the Cooke system. In the new larger unit (8¼" aperture) a four component lens of the Omnar system is used. *The image is sharp throughout the field, free of aberration, astigmatism, and distortion.*

Literature of new model polariscope now available

POLARIZING INSTRUMENT CO., Inc.
41 East 42nd Street, New York 17, N. Y.

**T.M. Reg. U. S. Pat. Off. Polaroid Corporation*

• Keep Informed

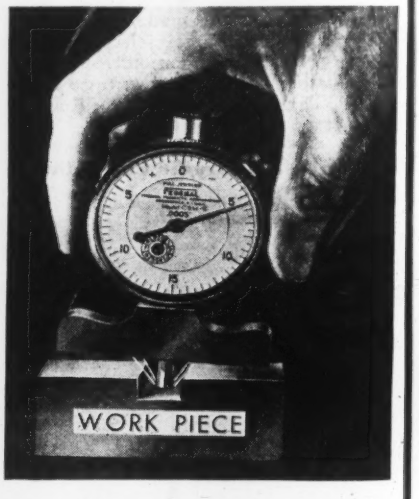
dials when an unexpected traffic change occurs. In an interconnected system, the device can be used with triple reset and remote-cycle change regardless of which dial is operating.

Each dial has its own dial-contact block, the contacts operating the various controller elements in the same manner as in a single-dial controller. A gear system allows the driving motor to turn all the dials synchronously at the same speed.

As in standard controllers, all parts are large and widely spaced for ready access. The basic design is similar to that of other G-E controllers, with the same parts and sub-assemblies.

New Cushioned Movement Is Developed by Federal Products

A new shock absorbing mechanism termed "Cushioned Movement" has been built into their Dial Indicators by Federal Products Corp., Providence, R. I. In perfecting this new "Cushioned Movement," exhaustive practical tests were made on all available types of shock absorbing mechanisms, as applied to Dial Indicators, and the result is a distinct improvement in precision gaging.



The function of the "Cushioned Movement" is to absorb the impact of sharp blows or rough handling, so that the force of these is cushioned before it reaches the small gear teeth, jewels, pivots or other intricate parts of the Indicator Mechanism itself, and causes basic injury to the instrument. The efficient Federal Indicator movement has not been altered, nor is the size and appearance of the Indicator changed in any way.

Ample use in the field under diverse trying conditions, has already fully demonstrated the economic value and practicability of this new "Cushioned Movement." In one instance a user checks the depth of over 40,000 fuse

SAVE WASTE PAPER!

• Keep Informed

parts per day without trouble or repairs on the Indicator. In another case, one "Cushioned Movement" Indicator was in constant use for 16 hours a day, 6 days a week, under what was referred to as "very abusive" treatment; careful examination following this use showed that all mechanical parts of the Indicator were in perfect condition with its repetitive accuracy unimpaired.

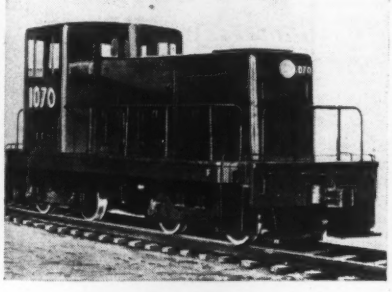
All regular Improved Movement Federal Indicators having A.G.D. range in C, D & E sizes (English Dials) and P, Q & R sizes (Metric Dials) can now be furnished with the new "Cushioned Movement." The exception to this are models E3BS and Q6IS.

Regular Federal Dial Indicators now in use (with the exception of the B sizes) may be returned to Federal for the purpose of installing the new "Cushioned Movement," at a nominal cost.

Continual improvements such as the "Cushioned Movement" is one of the reasons for the wide acceptance of Federal Precision Measuring Instruments among inspectors and production engineers.

G.E. Announces New 600-HP Locomotive

First production units of a new-type Diesel-electric locomotive suitable for both heavy yard duty and road service are nearing completion at General Electric's Erie (Pa.) Works, according to an announcement by G. W. Wilson, manager of the Company's Transportation Divisions. As described by Mr. Wilson, the new locomotive will be rated 600 hp, weigh 70 tons, and have a top speed of 55 mph.



"We believe the new 600-hp unit is the first railroad-type locomotive in the medium-weight class to develop such high horsepower," Mr. Wilson stated. "It will round out the G-E and Alco lines, fitting between the heavier 660- and 1000-hp Alco-G-E switchers and the 380-hp 44-ton unit."

Expected to find wide use in yard switching, scheduled road hauls, and transfer work, the new locomotive is adequately powered for passenger-station switching and light-traffic passenger service also. It is said to be particularly adapted for freight and passenger service on railroad lines where roadbed and rail weight require limited axle loadings.

The locomotive is powered by a six-cylinder Diesel engine rated 660-hp at 1000 rpm. The four motors and generators making up the electric drive were specifically designed by G-E for the new locomotive on the same basic principles which have been proved in the larger Alco-G-E units.

Barco Granted An Approved Rating

The Army Air Forces have granted an approved rating for outstanding quality, inspection procedure and control to Barco Manufacturing Co., it is reported by F. N. Bard, owner, Barco Manufacturing Co. In addition to its aviation devices for the war effort, Barco manufactures gasoline

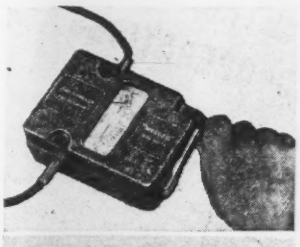
Continued on Page 36

WHICH "MEGGER" INSULATION TESTER is Best for You?

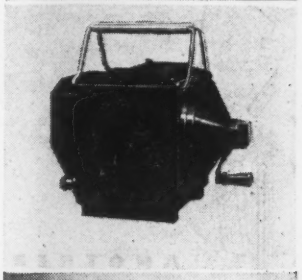
TRADE MARK REGISTERED U. S. PAT. OFF.

THE "Megger" line of instruments for testing electrical insulation is complete for ranges from a fraction of an ohm to 10,000 megohms, between which limits practically every insulation resistance measuring requirement falls. There are specific instruments for specific requirements and other types for more general use. Some users find one instrument suitable for all work, while others have use for several types.

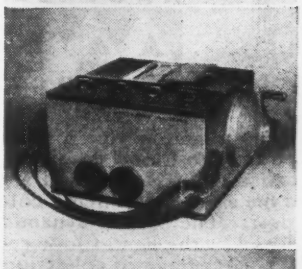
If you are uncertain which type and range of "Megger" instrument is best for your particular needs, write us, telling the type, size and rating of your equipment. We will gladly make recommedations. Write also for *Pocket Manual of "Megger" Practice*, No. 1420-*M*.



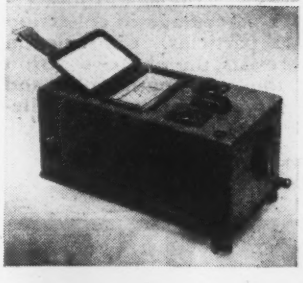
The New U. S.-Made Midget "Megger" Tester—*In many ways the most remarkable "Megger" instrument ever built. Weighs only 3 lbs—will fit an overcoat pocket or tool kit. Reads up to 50 megohms. Generates 500 volts and is always ready for use anywhere because of the hand crank. Bulletin 1785-M.*



The U. S.-Made "Megger" Insulation Tester—*Contains the usual "Megger" direct-reading true ohmmeter, of the permanent magnet moving coil type, mounted with a d-c hand generator in a plastic molded case. Ranges up to 2000 megohms, with hand generators up to 1000 volts. Widely used in hard service. Variable-pressure ("Meg") and constant-pressure ("Super-Meg") types. Bulletin 1735-M.*



The "Bridge-Meg" Resistance Tester—*This instrument is a combined "Megger" Insulation Tester and a four-dial, multi-ratio Wheatstone Bridge. Will measure any ohmic resistance from .01 ohm up to 100 or 200 megohms; hand generators rated up to 1000 volts. A complete and compact unit that is ideal for power companies and industrial plants. Catalog 1685-M.*



High-Range "Megger" Testing Set—*The original heavy-duty type "Megger" Testing Instrument. Made in all ratings up to 10,000 megohms and 2500 volts. A combination high-potential testing and insulation resistance measuring set. Hand- and motor-driven types. Catalog 1685-M.*

JAMES G. BIDDLE CO. • **1211-13 ARCH STREET PHILADELPHIA 7, PA.**

MECHANICAL RESEARCH COMPANY

ADVANCED ENGINEERING

Specializing in new development and design conception, requiring originality and exceptional mechanical experience and ingenuity.

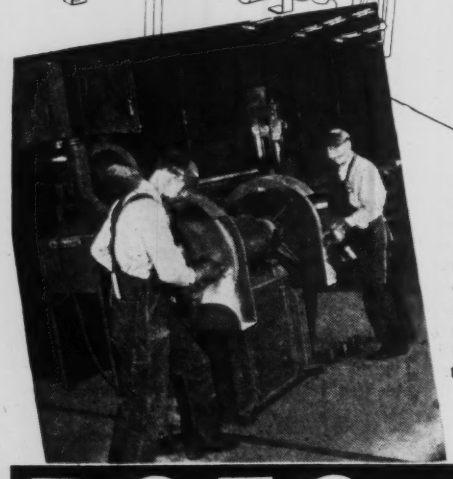
Also undertake the redesign or simplification of existing products or machines, complete to the final production detail and assignment of patents.

100 Pearl St. Hartford, Conn.

THE TYPE "D" ROTO-CLONE WITH VISCOUS FILTER AFTER-CLEANER

CLEAN AIR TO WORK ROOM THROUGH VISCOUS FILTERS
Best Possible DUST CONTROL FOR GRINDING OPERATIONS
COLLECTED GRINDER DUST
ROTO-CLO

ANOTHER AAF PRODUCT



● This phantom view of the Type D Roto-Clone shows the simplicity of exhaust ducts and hood arrangement and the ease with which it collects grinder dust. The proven dynamic principle employed by the Roto-Clone results in a higher percentage of collection of the very small particles. Construction is sturdy and resists the abrasive action of metal dusts, thus assuring long life and freedom from servicing. Send for Bulletin No. 272.

AMERICAN AIR FILTER CO., INC.
103 Central Ave., Louisville 8, Ky

ROTO-CLONE
FOR ALL GRINDING OPERATIONS

• Keep Informed

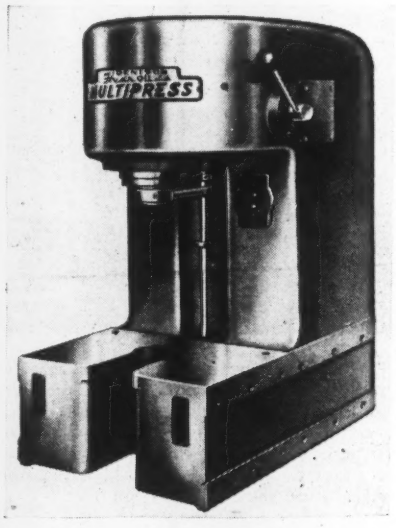
hammers, flexible ball joints, and many steam, air and hydraulic specialties for industries and railroads.

The new "Approved Quality Control Rating" is the U. S. Army Air Forces' official expression of confidence, and is assigned to a manufacturer who has demonstrated that its own inspection organization can be entrusted with full responsibility for meeting all requirements of the Army Air Forces. It eliminates all future need for duplicate Air Corps inspection during fabrication of the product.

Barco supplies the Air Forces with many parts, among them parts for the famous superfortresses, the B-29's.

New Vibratory Hydraulic Pressure Principle Announced

What is reported to be a new and revolutionary principle of Vibratory Hydraulic Pressure, has just been announced by The Denison Engineering Co., designers and builders of special and standard oil-hydraulic machinery and equipment. Engineers of the Columbus, Ohio organization, who are responsible for the development of this new principle, forsee its use in many types of both heavy and light industrial equipment where rapidly, or slowly, repeated application of regulatively uniform hydraulic pressure upon a moving machine element is desired. Company representatives term it the most startling advancement of the decade in the field of oil-hydraulics.



Its inventors have first applied this Vibratory Hydraulic Pressure principle in their widely publicized "Multipress," a many-purpose oil-hydraulic bench press which was introduced to industry at the Metals Congress Exposition in Cleveland, last Fall. Although the principle is applicable to any hydraulically-powered moving machine element, its control upon the action of the ram of that press serves very well to describe its basic functions.

In the Multipress, this new Vibratory Hydraulic Pressure principle makes it possible to regulate the ram's movements so that it will automatically make any number of repeated pressure strokes upon the work. By merely depressing the hand, or foot, control lever, the ram is caused to descend upon the work from its full upstroke limit and, without further movement of the controls, automatically make short, repeated, uniform-pressure strokes until the control lever is released by the operator, whereupon the ram rises to its

• Keep Informed

full upstroke position and stops. Pressures to be exerted by the ram in the repeat strokes can be easily regulated and pre-set for any degree between 1,600 and 8,000 pounds (the latter figure being the maximum capacity of the 4-ton Multipress which is used here for descriptive purpose). The number of those strokes can be from one to infinity. Frequency of these short, repetitive strokes is, naturally, influenced by ram speeds; also by stroke length or distance of ram travel, which is closely regulative from a few thousandths of a half inch. For example, the Multipress will deliver 500 four-ton repeat strokes per minute at its 1/8-inch stroke setting. Any shorter setting of length of repeat strokes, increases their frequency until, at a .004-inch setting, ram movement becomes virtually high-frequency vibration and nearly imperceptible to the eye. Furthermore, regardless of how much the work may be compressed, or compacted, during this repeated and rapid application of short pressure strokes, the ram will follow it downward, exerting the same uniform pressure constantly.

Automatic Cycling is an accessory control feature developed by Denison engineers to augment those of the Vibratory Hydraulic Pressure principle. When used in conjunction with Vibratory Pressure, this Automatic Cycling affords even more unusual ram actions. For example, through this combination, and by means of a single control lever, the hydraulically powered ram will descend, contact the work, make any pre-set number of uniform-pressure repeat strokes between 1 and 25, rise to the pre-set upstroke limit, and immediately descend again to repeat that operation continuously until the control lever is moved back to idling position. A single-cycle position of the lever is available for use during set-up work.

As pointed out by the manufacturer, application of the Vibratory Hydraulic Pressure principle to a hydraulic press, immediately adapts it to such operations as powder consolidation, high-speed stamping, forming, forging, rivetting, broaching, trimming, etc. Application of the principle to machinery and equipment other than presses is being exhaustively tested in the company's laboratories. Experiments thus far are said to demonstrate extreme versatility.

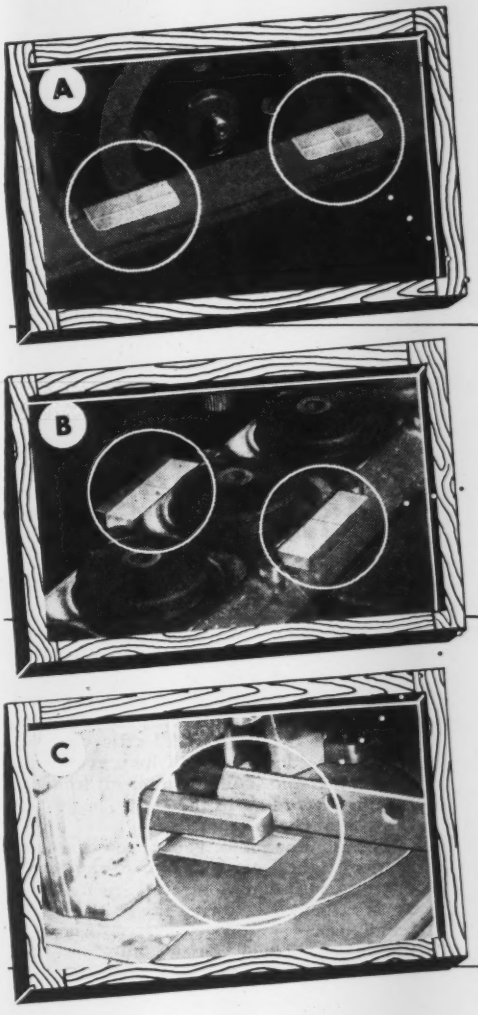
For those not acquainted with the company's "Multipress," it is a streamlined, completely self-contained, bench-size oil hydraulic machine that will deliver up to 4 tons downstroke pressure and up to 5,000 pounds "pull-up" pressure. It has a daylight opening of 12"; a work table of 16" x 10½"; a throat opening of 6"; an overall dimension of 16" x 26" x 34"; and weighs only 745 pounds. Ram speed can be regulated from a maximum of 200 ipm to 20 ipm. Stroke length and ram pressure are accurately controllable. Free of any projecting parts the unit is especially suited to gang-type arrangement in minimum space. Power is furnished by a 3 hp electric motor. A 6-ton unit of the same size and general specifications, has just been announced by the company.

Three Special Welding Courses Being Conducted at Lincoln Electric

Three new, specialized courses in arc welding are announced by The Lincoln Electric Co., Cleveland, Ohio, which are designed to increase the student's knowledge of the shielded arc process as applied to specific metals and structures.

The courses consist of one two-week training period to instruct enrollees in the technique of arc welding the common steel alloys and non-ferrous metals. A second

Continued on Page 38



Design to *Minimize* Maintenance

Insert KENNAMETAL *at Critical* Wear Areas

LIKE the jewels in a fine watch, small pieces of Kennametal, incorporated at critical points of excessive wear, assure enduring precision performance. For example:

(A) Kennametal inserts in the grinder table provide a true, flat surface that shows no appreciable deterioration after many months' service.

(B) Inserts of Kennametal stand up for weeks under severe abrasive action of wire cleaning brushes which cut deep into steel leveling guides in less than one day.

(C) Steel sliding surfaces of abrasive saw rest wore quickly, until reinforced with flat blanks of Kennametal, which make smooth, durable surface that outwears steel up to 100 times.

These typical applications of Kennametal, in simple forms, suggest how its unique wear-resistant properties can be utilized to make your product give better service at less cost. Keep in mind that Kennametal can be molded into almost any shape, limited only by reasonable proportions, but . . .

For the present—because our efforts are devoted primarily to the manufacture of tools for use in war plants—we can serve you most effectively if you plan to use readily available shapes of Kennametal, such as flat blanks, balls, and discs. However, if your wear problem is not easily solved with standard shapes, don't hesitate to ask us to suggest how it may be solved through freer, more imaginative application of Kennametal—the metal that masters wear.

Why KENNAMETAL Withstands Wear . . .

- 78 Rockwell C hardness, as compared to 66 for hardened tool steel.
- Low coefficient of friction with other metals; non-galling.
- Dimensionally stable; creep is negligible.
- Modulus of elasticity is 2 to 3 times that of steel; effective resistance to deformation.
- Highly resistant to corrosion, erosion, and oxidation by electric arcs.

KENNAMETAL
SUPERIOR CEMENTED CARBIDES
KENNAMETAL Inc., LATROBE, PA.

The COMPACTNESS and arrangement versatility of the IMO pump are illustrated by this tandem mounting of two separate IMO pumps on a common shaft, such as can be used on a Diesel, where one pump is needed for lubricating oil and the other for scavenging oil. Where space is limited, IMOs fit.

For further information send for catalog I-122-A

IMO
PUMP DIVISION OF THE
DE LAVAL STEAM TURBINE CO.
TRENTON 2, NEW JERSEY
I MOVE OIL

• Keep Informed . . .

course of one week's duration is devoted to instruction in welding sheet metal in thicknesses of from 12 to 20 gauge. A third two-week course is intended to train students in the welding of pipe in diameters of from 2 to 10 inches.

Those now enrolled in these post-graduate courses of instruction and who are already skilled in the welding of mild steel, represent a wide variety of industries throughout the country.

The courses are under the supervision and direction of Arthur Madson, veteran Lincoln instructor at the company's plant where a school for the training of men and women in the art of arc welding has been conducted uninterruptedly for nearly 30 years. Being the oldest school of its kind in continuous existence, it has trained over 25,000 people in this rapidly growing profession.

Crane Stability Gage Lessens Danger In Floating Drydock Ship Repair

Schenectady, N. Y., July—Dangerous work repairing ships aboard a floating drydock—work in which a miscalculation can mean loss of both lives and equipment—has been made considerably less perilous through the use of the General Electric crane stability gage, a device which helps prevent boom-type cranes and similar equipment from overturning, according to the Navy, biggest user thus far of the instrument.

The floating or advanced base sectional drydock—the Navy's answer to the problem of repairing damaged craft near combat areas rather than towing the craft back to a home base—employs a system whereby a number of special repair ships are linked together, submerged, then resurfaced immediately under the vessel needing repair.

Because of the floated condition and because the crane travels on a relatively narrow gage track, cranes used aboard such a drydock are more easily subject to overturning when their maximum load is passed. An overturned crane can result in loss of lives, damage to equipment, and stoppage of repair work.

With the G-E crane stability gage, however, the operator knows at all times the stability of his crane by means of an indicating instrument in front of him. If the crane attempts to pick up too great a load, the instrument will indicate the unsafe condition to the operator. The gage also acts as a safeguard against extending the boom to an excessive radius for a given load, thus eliminating dependence upon the operator's judgment.

Use of the gage also tends to speed up work. Because the operator, without the gage, seldom has an accurate idea of the load he is handling, he has a tendency to limit the load well below the maximum safety mark, and thus maximum service is not obtained. With the gage, he knows at all times exactly what the limit is.

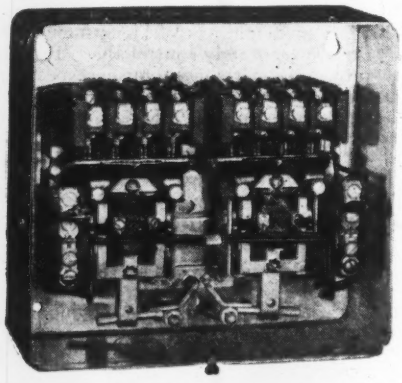
The stabilizing device has proved particularly valuable when several cranes are used jointly on one job. When one crane begins to support more than its share of the load, the operator is warned of the unsafe condition.

On some electrically operated cranes, the crane stability gage can be interlocked with electric controls in such a way that the operator automatically will be prevented from lowering the boom or hoisting the load if the gage indicates an overload. The operator can only raise the boom, decreasing the radius of operation, or land the load. Either action returns the crane to a safe operating condition.

Through use of the device, an alarm can be made to sound automatically just before the unsafe limit of the crane is reached.

Semi-Interference-Type Mechanical Interlock Featured in General Electric's New Starter

A new a-c magnetic reversing starter, featuring a semi-interference-type mechanical interlock, has been announced by the Industrial Control Division of the General Electric Co. Available in sizes 0 and 1, the new starter is designed for full voltage starting of squirrel-cage induction motors, although it can easily be used for reversing service when combined with a reduced voltage starter.



Easy to adjust, the new semi-interference-type mechanical interlock prevents the closing of one contactor while an arc is maintained on the other, thus averting a short circuit through the arc and the resultant burned

"Vintage . . . about 1910"

Kicked around . . .
Beaten up . . . Still Works!

WHEN the airplane was only a box-kite, this well worn relic left the Lonergan shop . . . a shiny, new gauge with years of dependable service ahead of it.

Recently, in a shipment of old gauges sent by a customer to our Repair Department in Philadelphia for test and calibration, the sorry old wreck turned up.

Curious to see what would happen, someone put the gauge on test. It surprised everybody—checked out almost letter perfect to 140 lbs., which was as far as the battered socket would hold. Most interesting of all was the discovery that the gauge had an old slide-type movement discontinued by Lonergan in 1910!

* * *

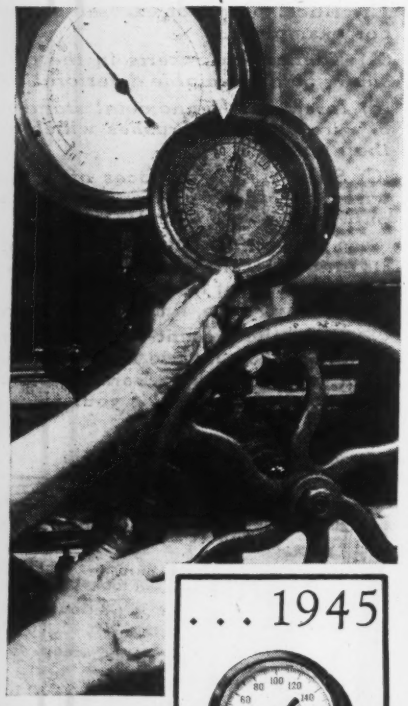
Lonergan built good gauges back in those days—and it is building them better than ever today. With many advanced design features . . . exacting standards of manufacture . . . superior workmanship and "finish" . . . Lonergan gauges enjoy high standing all through Industry.

Lonergan gauges are made in all types and sizes . . . with nation-wide service through distributors. Write for Information Bulletin 503-A—a condensed catalog list of our most popular models.

J. E. LONERGAN COMPANY, 216 N. 2nd St., Phila. 6, Pa.

Lonergan

Safety Valves ● Relief Valves ● Pressure Gauges
SINCE 1872 — Makers of Pressure-Safety Appliances for the Power, Mechanical, and Process Industries



. . . 1945

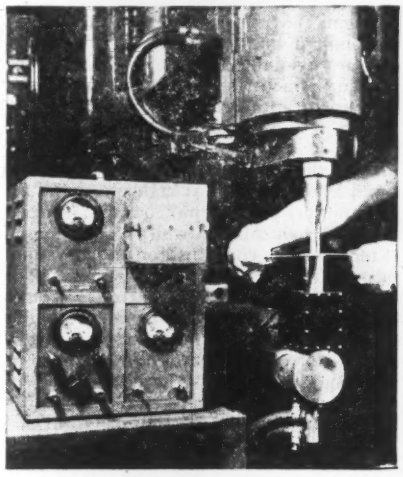
RIGHT—Lonergan "Superline" gauges, bronze and steel tube types, meet highest standards of instrumentation.

• Keep Informed

contacts and blown fuses. In addition, the interlock arm of the closing contactor assists the interlock arm of the opening contactor in reaching its fully opened position. These interlock arms are case-hardened and their underside faces are buffed and polished to provide long life.

Other features incorporated in this starter are under voltage protection when used with a push-button station or other momentary pilot-circuit device; undervoltage release when used with selector or limit switches; and tamperproof, self-contained overload relays which allow the motor to operate up to its maximum safe temperature before tripping it off the line. The starter is housed in a sturdy metal enclosure $9^{7}/_{8} \times 13^{5}/_{8} \times 4^{9}/_{16}$ in size, equipped with a hook-on cover and finished with smoothly rounded corners. Dust-tight and watertight enclosures are furnished where special conditions warrant.

New Current-Force Recorder Announced by General Electric



A new current-force recorder for recording current and force in resistance welding machine electrodes has been announced by the Special Products Division of the General Electric Co. Desirable for use in welding research and for the periodic checking of welding machine performance, the new recorder is specially designed to be helpful to users of energy-storage type welding machines for determining when forge pressure is applied to the work with respect to the discharge of welding current. In addition, the recorder permits resistance welding machine users to comply with Navy Specifications, Navaer PW-6A, Bureau of Aeronautics, Specifications for the Spot Welding of Aluminum Alloy, for Class A Spot Welding.

Compact, portable, and easy to use, the recorder consists of an amplifier-oscillograph unit and a special electrode holder. The amplifier-oscillograph unit, which operates from a 115-volt, single-phase, 60-cycle power source, is composed of a single-channel amplifier, an oscillator, a power unit, and a small magnetic oscillograph, all housed in a sturdy metal case. This unit simultaneously records a timing wave, the rapidly changing electrode force, and the electrode current of the welding machine while a weld is being made. The record produced by the recorder also indicates squeeze time, the duration and magnitude of the welding current, the rate of rise of forge pressure, and the hold time. The special electrode holder is equipped with strain gages for measuring compressive strain, which is a measure of the force in the electrode, and a built-in shunt for diverting

Continued on Page 40

for the handling of all inflammable gases and liquids

Throughout industry in general, the use of inert gas is finding rapidly expanding safety applications. Its use can greatly reduce the hazards of processing, handling, and storing explosive and inflammable gases or liquids.

The Roots-Connersville Inert Gas Generator is a simple, dependable machine for producing this oxygen-free gas at low cost. Uses oil or gas for fuel. Portable or permanently installed models. Capacities from 1,000 to 100,000 c.f. hr.

Shown in photo is an interesting application of an "R-C" Inert Gas Generator installed in a prominent synthetic rubber plant. In this instance the inert gas is used for repressuring hydrocarbon tank cars, blanketing butadiene and styrene storage tanks, and purging processing equipment.

Let us discuss the possibilities of applying this modern safety measure to your operations.

ROOTS-CONNERSVILLE BLOWER CORP.
ONE OF THE DRESSER INDUSTRIES
508 Michigan Avenue, Connersville, Ind.

WRITE FOR BULLETIN 100-B-14

Roots CONNERSVILLE SINCE 1854 *Inert Gas* GENERATORS

from the electrode a proportional amount of current, which is used to operate an oscillograph galvanometer.

In operation, a 5000-cycle voltage from the oscillator is applied to two points on the strain gage bridge circuit, and the output from the two opposite points is a measure of the force on the electrode. The output of the bridge is fed into the amplifier, which amplifies the modulated carrier and rectifies and filters the amplified output. The output is then fed to the oscillograph, where the record is made. The welding current and a 60-cycle timing wave are recorded simultaneously on the $3^1/_2$-inch paper record.

New Fatigue Testing Machines

Philadelphia—Increasing demand for fatigue testing machines that will handle small pieces or sub-assemblies of larger structures has led to the development and production by The Baldwin Locomotive Works' Southwark Division of two new pieces of testing equipment. Special features of these machines will make it possible to approach an actual field test much closer than before. It should be valuable for the testing of automotive and airplane parts or any structural components or specimens.

The Southwark Universal Fatigue Testing Machine which provides a dynamic load application of 20,000 pounds in one direction is made possible through an hydraulic preloading attachment of 10,000-pound capacity. The high operating speed of approximately 2,000 load cycles per minute, at constant force as opposed to constant deflection, are two important advantages over other machines.

Any predetermined alternating load is kept automatically constant regardless of the changes of deflection that may occur in the specimen under test. Other slower speed machines, whose load is applied with eccentric cranks, maintain a constant alternating deflection, regardless of load.

Accessory tools for testing various sizes and shapes of specimens in tension or compression, bending or torsion, are available. The standard distance between plates is four feet, but the machine can easily be adjusted for longer specimens.

The dynamic load is produced by a centrifugal force type oscillator, the force of which is amplified by working near resonance of the system. The load is measured and controlled electronically. The maximum alternating force is plus and minus 10,000 pounds, which may be applied in increments of ten pounds.

Southwark's other new Universal Fatigue Testing Machine of 1,000-pound alternating force capacity also has a static preloading attachment which results in a force capacity of 2,000 pounds in one direction. It was developed for tests in tension-compression, bending or torsion.

The torsion testing attachments for the latter have a capacity up to 30,000 inch pounds and permit the testing of specimens exceeding one inch in diameter. The standard tension-compression fixture for testing specimens is equipped with tapered collets to grip plain cylindrical pieces. Bending fixtures are available up to 6,000 inch pounds bending moment for testing flat plate specimens up to approximately $^3/_8$ inch in steel, $^1/_2$ inch in aluminum alloys and one inch in plastics.

As in the other new machine, this 1,000-pound tester operates at high speed and may be set for any predetermined alternating load which is then automatically kept constant. An inertia force compensator of every simple construction cancels all inertia forces, and the accuracy of loads transmitted is kept well within plus or minus two percent. The entire mechanism of the machine, including the large T-slotted work table attached for use in testing assemblies, structural components or parts, is seismically suspended in the frame to eliminate the transmission of vibration to the floor.

Heilman-Badenhausen Boiler

R. E. Moyer, Vice-President Charge of Engineering for Heilman Boiler Works, Inc., Allentown, Pa., states plant in production manufacturing *new* package water tube steam generator producing steam at high pressure utilizing Diesel Engine waste gases also fired with manual or automatic oil burner.

The new steam generator can operate together or separately with waste engine gases or oil burner gases producing steam.

R. E. Moyer states this steam generator will be of great value when operated with gases from gas turbines, Diesel Locomotives.

Cherry Rivet "E" Award

The Army-Navy "E," "for high achievement in the production of material of war," has been awarded to the Cherry Rivet Company of Los Angeles. Presentation ceremonies were held at the Cherry Rivet plant, 231 Winston Street, Los Angeles, recently.

STURTEVANT
Sensory
TORQUE WRENCH
-HEAR-FEEL-SEE-
clicks
This wrench "CLICKS" with Management because Reflex Torque Control is far faster and is uniformly accurate.
It "CLICKS" with Operators too, because it eliminates eyestrain and need for sustained close attention.
It "CLICKS" with Tool Buyers, for it is fast under all working conditions (in bad light, blind spots or deafening noise). The STURTEVANT Sensory Torque Wrench is permanently accurate.
with MANAGEMENT
with OPERATORS
with TOOL BUYERS
31 Capacities—ranges from 0-8 inch ounces to 0-7200 inch pounds.
P.A. STURTEVANT CO.
ADDISON ILLINOIS
QUALITY
THE WORLD'S LARGEST MANUFACTURER OF TORQUE WRENCHES

• Keep Informed

Captain B. C. Tarnutzer, Public Relations officer, Western District, Air Technical Services Command, acted in the capacity of Master of Ceremonies.

Lt. Comdr. Wiley E. Wright, Assistant Deputy Commander, Western District, Air Technical Services, presented the "E" pennant to William B. Hubbard, President of the Cherry Rivet Co. Lt. Col. E. G. Loomis, USNR, presented the "E" emblems to the employees. Dr. Max Mason, Chairman Observatory Council, California Institute of Technology, was the guest speaker.

New Industrial Electronics Training Course Announced by General Electric

A new Industrial Electronics talking slide film training course which offers a thoroughly practical and quickly grasped understanding of the subject of industrial electronics, has been announced by the General Electric Co. Carefully organized for presentation in twelve sessions, the new course is expected to have wide use throughout industry wherever electronic equipment is applied or a knowledge of it is required. A large number of industrial and power companies, especially, are expected to find the course highly desirable for effectively presenting to their personnel the fundamentals and applications of industrial electronics.

In industrial plants, the course should provide electrical personnel with sufficient theory and application information to acquaint them with electronics in general; production and process engineers engaged in reducing production costs should find that it offers innumerable practical suggestions; designing engineers involved with improving products should obtain much stimulation and a variety of new ideas; practical electricians should acquire from it an increased working knowledge of electricity and ample information to encourage them to install and service electronic equipment; and production managers and plant superintendents should discover a wealth of opportunities for cracking open production bottlenecks by electronic methods.

In electric power companies, the course is certain to provide new power sales engineers with the background necessary for them to deal helpfully with customers; veteran power sales engineers and other utility men should find it particularly beneficial for "brush up" purposes; and power sales departments should discover that it is ideal for training program purposes for interested men in their industrial customers' organizations.

Presented throughout in a clear, nontechnical manner, the course consists of twelve talking slide films (35-mm film strips and 16-inch, $33^1/_3$-rpm records) each approximately thirty minutes in length; twenty-five copies each of twelve lecture review booklets keyed to the slidefilms; an instructor's manual covering the presentation of all twelve lectures; and an attractive, sturdily constructed carrying case designed to accommodate the complete course.

The introductory slidefilm, "Harnessing the Electron," illustrates the wide range of applications of electronic tubes and their four fundamental uses, while the second film, "Electronic Tubes as Rectifiers," describes in interesting detail the three important types of rectifiers, the kenotron, phanotron, and the ignitron. The grid control of electronic tubes is discussed at considerable length in the third film, and the fourth and fifth cover the fundamentals of electricity, so necessary to the understanding of electronics. Six of the remaining films are devoted to photoelectric and electronic relay

Continued on Page 42

BB_2 = Double rows of Ball Bearings
EP = Effective Packing Element
P/V = Pressure or Vacuum
LT = Low Torque under all conditions.

Perfect flexibility with low torque is assured in every CHIKSAN *Ball-Bearing* Swivel. Yet Chiksan design and construction are so sound they can be expressed in a simple formula. There is nothing to tighten or adjust... no stuffing boxes to put the brakes on easy turning and thus produce excessive strains on pipe lines and fittings. Smooth, easy turning throughout 360° is provided in one, two and three planes. Packing Element is so effective the same Swivel may be used for either pressure or vacuum service... for loading or unloading. Chiksan *Ball-Bearing* Swivels are built for pressures to 3,000 p.s.i. and varying temperatures. Write for latest catalog.

Chiksan Representatives in Principal Cities
Distributed Nationally by Crane Co.

CHIKSAN TRADE MARK REG.
BALL BEARING SWIVEL JOINTS FOR ALL PURPOSES
CHIKSAN COMPANY
BREA, CALIFORNIA

FRASER-BRACE ENGINEERING CO., Inc.

Design, construction and installation of complete plants and projects

Mechanical, Heavy Industries, Shipbuilding, Hydro-Electric Developments, Power Plants, Chemical and Refining Plants, Process Industries, Metallurgical Developments and Processes, Explosives, Plastics, Water Supply and Treatment, Sewage and Industrial Wastes Treatment.

• REPORTS • APPRAISALS • CONSULTING •

10 East 40th Street New York 16, N. Y.

The long and short of

TUBE CLEANERS FOR CURVED TUBES

The short, small diameter motors necessary for passage through short radius bends impose harsh restrictions on the power such motors will develop. This lack of power often slows up tube cleaning. It may even cause serious time charges through excessive down-time of equipment cleaned.

Wilson cleaners for curved tubes will help you overcome these and other troubles. There is a Wilson Tube Cleaner for every curved tube from 1" O.D. up and for almost every radius. Let a Wilson Tube Cleaner cut your down-time and solve your curved tube cleaning problems.

Thomas C. Wilson, Inc. maintains a large engineering staff for consultation on difficult or unusual tube cleaning problems. Write today for a copy of the new Wilson Tube Cleaner Check List and a 40-page bulletin describing the complete line of Wilson Tube Cleaners. No obligation.

Modern tube-cleaners for the problems of today.

wilson
PIPE AND TUBE CLEANERS EXCLUSIVELY

THOMAS C. WILSON Inc.
21-11 44th AVENUE, LONG ISLAND CITY 1, NEW YORK

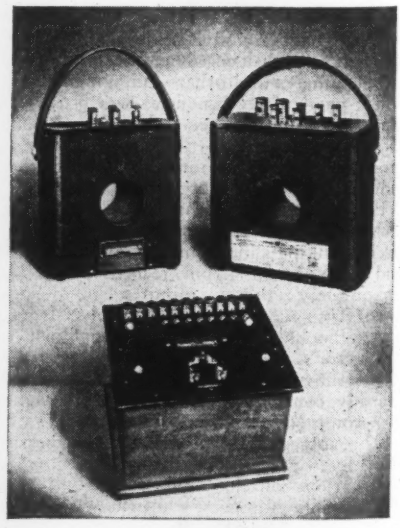
• Keep Informed

systems, electronic rectifier equipment, the Thy-mo-trol drive, electronic heating in industry, and the electronic control of a-c power, respectively. The final film, "Electronics—Today and Tomorrow," summarizes the present-day application of electronics and discusses the general trend of industrial electronics and its wide possibilities in the postwar world. Cartoons, animated drawings, and analogies, and simple, direct diagrams are used extensively throughout the film, and the many views of typical electronic applications in industry today are notable for their clarity and detail.

Commenting on the course, L. A. Umansky, Assistant Manager of General Electric's Industrial Engineering Divisions, said: "The need for a course of this particular kind—a course easily presented to and quickly understood by the greatest possible number in the industrial electronics field—has been sharply felt for some time. It accomplishes two distinct and equally important purposes. In the first place, by explaining the elementary facts of electronics in a simple form, readily understood by practical men, it destroys the fear of the unknown and encourages them to use this new tool as freely as they used other and older electrical tools. Secondly, the course points out what can be rightfully expected of electronic applications, where they can solve an industrial problem, or can offer a new and better way of tackling it; or where the use of electronics would be merely a fad or a misapplication. For only in this way will electronics find its rightful and legitimate place in the industrial life—to improve the product, simplify its manufacture, lower its cost, and increase its output."

Portable Current Transformers

A new line of portable current transformers, Types JP-2, -3, and -4, has been announced by the General Electric Co.'s Meter and Instrument Division. All three types are highly accurate and may be obtained as multirange units. Type JP-2 is also available as a single-range unit.



The JP-2 and -3 units meet the accuracy requirements of the ASA 0.3 accuracy class with burdens B-0.1, -0.2, and -0.5 at 60 cycles. Both units, of the through-window-type construction, are suitable for laboratory-standard work or for testing work in the field. The JP-2 is not supplied with a primary winding, but there is a hole in the core through which a cable or conductor can be passed. However, there is a tapped second-

• Keep Informed

ary winding, and the terminals on top of the case are all secondary terminals.

The JP-3 unit is designed with a combination of wound-primary and through-primary construction. Ratings of 100 amperes and below are obtained by a wound-primary with the terminals on the top of the transformer. By passing a conductor through the transformer window once, 1000- and 1200-ampere ratings may be obtained. Additional ratings may be gained in both units by passing the conductor through the window two or more times.

Both the JP-2 and -3 units are insulated for use on circuits not exceeding 2500 volts. They can, however, be used over cables on higher voltage circuits, provided the cable is insulated for the circuit voltage.

The cases are made of aluminum with a durable, black, crystalline-lacquer finish. The top of the cases are black compound, and a leather carrying handle is provided for portability.

The Type JP-4 transformer is designed for highest-grade application as a laboratory standard. It is of wound-primary construction with taps in the primary coil for the different ratios. Each primary coil, 0.25 to 15 inclusive, is protected by a removable fuse. The secondary terminals are provided with a short-circuiting switch, and also with a Thyrite protector to guard against accidental opening of the secondary circuit.

The unit is enclosed in a walnut-finished wooden case. The top of the transformer is of black compound, and all the terminals are mounted on the top.

Illinois Gear Receives Fifth Award

For the fifth time, the Army-Navy Production Award has been presented to the Illinois Gear & Machine Co., 2108 N. Natchez Avenue, Chicago, Ill., for outstanding service in the production of war equipment. This is the fourth renewal of the award presented originally on January 23, 1943.

In a letter addressed to the men and women of Illinois Gear on June 23, 1945, Mr. Robert P. Patterson, Undersecretary of War, stated that: "your standard of practical patriotism is one of which you may well be proud. This renewal (of the award) is a symbol of high achievement over a long period."

The Illinois Gear & Machine Co. has been engaged in making precision cut gears for planes, ships, tanks, gun operating mechanisms, etc., for the various branches of the armed services since the early days of America's participation in the war.

• BUSINESS CHANGES

Federal Products Corp. Now Has A Field Engineering Service Department

Federal Products Corp., manufacturers of Precision Measuring Instruments for controlling the dimensions of manufactured workpieces, has set up a Field Engineering Service Department to co-operate with the users of its instruments.

Knowledge and experience in the use of such instruments varies greatly. Too often an inspector is found using an unsuitable Gage, and frequently he may be using a suitable Gage, but using it improperly. Federal, therefore, provides the experience of Field Servicemen who, because of their contact with many gaging requirements and problems covering a wide variety of gaging

Continued on Page 44

To Help You CUT COSTS with CUTTING FLUIDS...

...Four Booklets

Machining costs come down and machining quality improves when cutting fluids are selected and used scientifically. To help you use cutting fluids to better advantage, D. A. Stuart Oil Co. has available four pocket-size booklets full of information gathered from over eighty years experience.

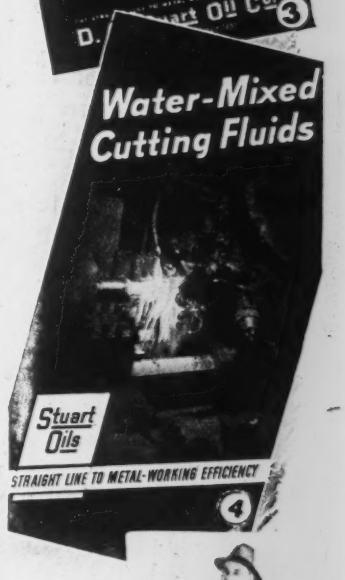
1. Cutting Fluids for Better Machining. A comprehensive 60-page hand-book on cutting and grinding fluids. Contains much data on general machining as well as oils.

2. Grinding with Oil. Deals with the use of oils for production, precision grinding.

3. The 577th Oil. Contains twenty-two case studies showing results of proper oil application.

4. Water-Mixed Cutting Fluids. A new booklet which explains the "how" and "why" of so-called "soluble oils" and gives many tips on how to handle them.

These booklets are yours for the asking. Indicate by number which you are interested in. *D. A. Stuart Oil Co. Limited. 2741 S. Troy St. Chicago 23, Illinois.*



D. A. Stuart Oil CO.
LIMITED
ESTABLISHED 1865
Stocks in Principal Metal-Working Centers

To Be Published in August

1945 Addenda to Power, Locomotive, and Heating Boiler Codes; Unfired Pressure Vessel Code, Material Specifications, and Welding Qualifications.

•

Among the most important revisions formulated this year and published in the 1945 Addenda are the incorporation of: (1) Alternate Rules for Fusion Welded Boilers (Paragraphs P-400 to P-409) in the Code, and (2) Boiler Code Interpretation Case No. 944 to provide for the use of the Assembly Code Symbol Stamp.

Other changes affect Table A-8; the stamping requirements for unfired pressure vessels; the rules for low-temperature vessels; some of the rules in the Codes for Heating, and Locomotive Boilers, and Material Specifications.

Keep your Code up-to-date by ordering these Addenda now.

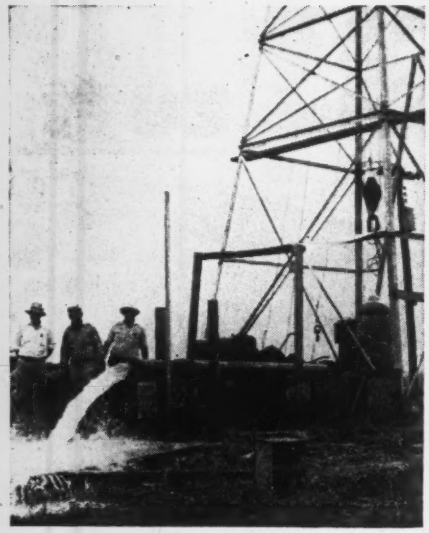
•

Price of 1945 Addenda—

—to Power Boiler Code	$0.40
—to Unfired Pressure Vessel Code	.40
—to Material Specifications	.50
—to Low-Pressure Heating Code	.05
—to Locomotive Boiler Code	.05
—to Welding Qualifications	.05

•

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
Publication Sales Dept.
29 West 39th St., New York 18, N. Y.



Industrial Expansion Will Call For

MORE WATER

And low cost per Million gallons is going to be a mighty important factor. That brings Layne Well Water Systems and Layne Vertical Turbine Pumps squarely into the picture. Layne Water Producing equipment has always been highest in efficiency, consequently lowest in cost to operate.

In the first place, Layne is the World's largest builder of Well Water Systems—and makers of the finest quality Vertical Turbine Pumps. For years Layne has operated in almost every part of the world, thus gaining experience and knowledge of unmistakable value. Layne built more Well Water Systems for World War II industries, camps, and air fields than any ten competitive firms combined.

If you are looking toward economy in your industrial water system, Layne has many basic facts to present—facts that may save you many hundred dollars annually. Write, wire or phone for further details. LAYNE & BOWLER, INC., General Offices, Memphis 8, Tennessee.

LAYNE PUMPS *—fulfill every need for producing large quantities of water at low cost from wells, streams, mines or reservoirs. Send for literature.*

AFFILIATED COMPANIES: Layne-Arkansas Co., Stuttgart, Ark. ★ Layne-Atlantic Co., Norfolk, Va. ★ Layne-Central Co., Memphis, Tenn. ★ Layne-Northern Co., Mishawaka, Ind. ★ Layne-Louisiana Co., Lake Charles, La. ★ Louisiana Well Co., Monroe, La. ★ Layne-New York Co., New York City ★ Layne-Northwest Co., Milwaukee, Wis. ★ Layne-Ohio Co., Columbus, Ohio ★ Layne-Texas Co., Houston, Texas ★ Layne-Western Co., Kansas City, Mo. ★ Layne-Western Co. of Minnesota, Minneapolis, Minn. ★ International Water Supply Ltd., London, Ontario, Canada ★ Layne-Hispano Americana, S. A., Mexico, D. F.

LAYNE

WELL WATER SYSTEMS
VERTICAL TURBINE PUMPS

• Keep Informed

applications, can be of help to users and prospective users of their instruments whose experience may have been limited to the confinements of their own plant or industry. Federal servicemen co-operate through the local representatives. Their experience is not confined to any one locality or trade, but is a composite obtained from long shop training, and contact from practice obtained in many different industries throughout the country.

Their services are available upon request whenever necessary.

New G-E Plant To Be Built at Tiffin, Ohio

To meet the anticipated postwar increase in small motors for electrical appliances and in ballasts for fluorescent lamps, General Electric has announced it has selected a site at Tiffin, Ohio, and is in the process of selecting a second site in another state for a new manufacturing plant both to be operated under the management of the company's Fort Wayne works. In making this announcement M. E. Lord, manager of the local plant, said buildings will be designed, equipment ordered and construction started as quickly as it is possible to do so.

"Employees of the Fort Wayne works have long observed the year-by-year increasing demand for fractional-horsepower motors for appliances and have seen the plant's facilities expanded until they have overrun the areas available for production," Mr. Lord's statement said. "The growth in fluorescent ballast production has been even more rapid.

"The new plants will also provide facilities for the manufacture of increased quantities of products that, we believe, will be demanded in large volumes for many years following the close of the Japanese war. Even with these new facilities, it is expected that postwar employment by General Electric in Fort Wayne will be in excess of the prewar levels."

McLaughlin Heads Tube Turns Engineering Service Division

Carl B. McLaughlin will head up the recently established Engineering Service Division of Tube Turns, Inc., Louisville, Ky., it is announced by John G. Seiler, the firm's Vice President in charge of sales. The division is rapidly developing new applications for Tube-Turn welding fittings.

McLaughlin formerly was associated with Tube Turns' Pittsburgh office. A native of Jacksonville, Ill., he graduated from the University of Illinois in 1931 and was a metallurgist-engineer with the U. S. Steel Corp. before joining Tube Turns in 1943.

USE LESS··SO OUR FIGHTING FORCES WILL HAVE MORE!

• Keep Informed

E. J. Hergenroether Returns to International Nickel from W. P. B.

E. J. Hergenroether, recently resigned Chief of the Metallurgical Branch of the Steel Division of War Production Board at Washington, D. C., has resumed his duties with the Development & Research Division of The International Nickel Co., Inc., New York, T. H. Wickenden, Manager of that Division, announces. Mr. Hergenroether will be in charge of the Division's automotive steel development and will make his headquarters in Detroit at the company's field office there.

He had served with the War Production Board and predecessor agencies, mainly in the Steel Division, in Washington since May 1941. Previous to this Mr. Hergenroether had been with the Detroit office of the International Nickel Co. for twelve years, advising various industries on metallurgical problems. Before joining International Nickel, he was Assistant Chief Metallurgist with the Cadillac Motor Car Co.

Farrel-Birmingham Appoints Robert M. Honegger General Manager of Buffalo Plant

Farrel-Birmingham Co., Inc., has announced the appointment of Robert M. Honegger as General Manager of the company's gear plant at Buffalo, New York.

Mr. Honegger received both his early and technical education in his home city of Buffalo and first became associated with the Farrel organization in 1925 as a member of the Engineering Department. In 1935 he was made general foreman and shortly after became plant superintendent, which position he held until the present appointment.

Mr. Honegger, in his present capacity, succeeds Lester D. Chirgwin, formerly of Buffalo and now of Ansonia, Connecticut. In March 1945, Mr. Chirgwin was elected Vice-President in Charge of Manufacturing in all four Farrel-Birmingham plants located at Ansonia, Derby and Stonington, Conn., and Buffalo, N. Y.

Deutsch Now With Builders-Providence

Fred W. Deutsch is now associated with Builders-Providence, Inc. (Division of Builders Iron Foundry), Providence, Rhode Island, as Assistant Sales Manager.

In his new connection, Mr. Deutsch will be concerned with sales of Builders' well known Water and Sewage Works Equipment and also the Company's Recording, Indicating and Controlling Instruments as manufactured for industrial applications.

Born in Brooklyn, New York, Mr. Deutsch attended Stevens Institute and has since been actively associated in the municipal and industrial equipment fields. For several years he was connected with the Permutit Company and later with the Duro Pump Co. In 1940 he joined the Everson Manufacturing Co., becoming Vice-President in 1943 and continuing in that office until resigning early in the current year.

Mr. Deutsch will make his headquarters in Providence, R. I.

Headquarters Sales Manager Appointed

Appointment of Harry L. Huntley as Headquarters Repair Sales Manager of the thirty-four plants of the Manufacturing and Repair Department of the Westinghouse Electric Corp. has been announced by H. F. Boe, Vice President. Mr. Huntley will have his headquarters in Pittsburgh, Pa.

Continued on Page 46

RUBBER CHURNS
NO CHANCE for the Fire Demon here
..FIRE-FOG IS ON DUTY
"AUTOMATIC"
FIRE-FOG
IT BLANKETS • IT ISOLATES • IT QUENCHES •

So sensitive to fire is "Automatic" FIRE-FOG that a mere wisp of flame is sufficient to bring action, immediate and decisive. This system of fire quenching converts water into a fine mist. It operates on the principle of quick response to heat—there's only a lapse of seconds between a blaze and its extinction. With FIRE-FOG nozzles strategically placed to cover every vulnerable area, absolute protection is assured. FIRE-FOG is entirely automatic in operation.

In addition to guarding rubber churns, FIRE-FOG is providing positive protection for oil quench tanks, enamel dip tanks, oil filled electrical equipment, gasoline loading racks and other hazards subject to fires of flammable liquid origin. Write for complete information—no obligation.

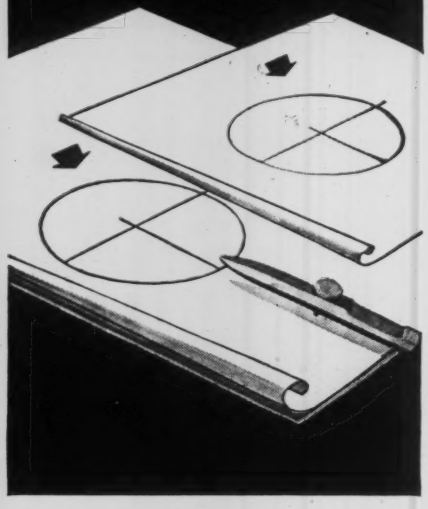
"Automatic" Sprinkler

"AUTOMATIC" SPRINKLER CORPORATION OF AMERICA

YOUNGSTOWN, OHIO . . . . . OFFICES IN 36 CITIES

"Automatic" manufactures and installs a complete line of fire protection devices and systems for all types of fire hazards. Listed by Underwriters' Laboratories, Inc., and approved by Factory Mutual Laboratories.

Tracing cloth that defies time



● The renown of Imperial as the finest in Tracing Cloth goes back well over half a century. Draftsmen all over the world prefer it for the uniformity of its high transparency and ink-taking surface and the superb quality of its cloth foundation.

Imperial takes erasures readily, without damage. It gives sharp contrasting prints of even the finest lines. Drawings made on Imperial over fifty years ago are still as good as ever, neither brittle nor opaque.

If you like a duller surface, for clear, hard pencil lines, try Imperial Pencil Tracing Cloth. It is good for ink as well.

IMPERIAL TRACING CLOTH

SOLD BY LEADING STATIONERY AND DRAWING MATERIAL DEALERS EVERYWHERE

• Keep Informed . . .

Born at Pittston, near Wilkes-Barre, Pa., Mr. Huntley attended public schools in his home town, then went to Bliss Electrical School, Washington, D. C., where he was graduated in electrical engineering in 1922. He then engaged in the application and installation of electrical equipment in the mining and textile industries and joined Westinghouse in 1926.

His first assignment was in service engineering and sales work in the Service Department at Philadelphia, and at this time he received additional training in industria engineering courses at Drexel Institute. In 1927, he opened the Service Shop at Wilkes-Barre, remaining there as manager until 1939, when he was transferred to Fairmont, West Virginia, to open and manage the Manufacturing and Repair plant. He was transferred to Pittsburgh in 1940 to organize and manage the Repair and Renewal Parts Sales Division for the Central District, in which capacity he has served until the new appointment.

PROFESSIONAL SERVICE

in ALL BRANCHES of the ENGINEERING FIELD

Consulting Engineers
Engineering Organizations
Constructors—Contractors
Patent Lawyers, Etc.

Power Plants and Electrical Distribution for Industry
Surveys, Reports, Design, Construction, Supervision
EDWARD R. FEICHT
Bala-Cynwyd, Pa. (outside Philadelphia)

Chemical and Metallographical Laboratories—Welding . . Supervision, Inspection and Testing Qualification of Operators and Procedure
THE JAMES H. HERRON CO.
Cleveland, Ohio

Power Plants • New • Rehabilitation
Steam Generation — Diesel and Steam Power
Z. KOGAN
Consulting Service
CHICAGO

Weld Testing—Qualification of Operators—Supervision—Inspection—Research
NATIONAL WELD TESTING BUREAU
Pittsburgh Testing Laboratory, Pittsburgh, Pa.

Patents Obtained and Searched for any Invention in U. S. Patent Office—Confidential Advice—Literature
Z. H. POLACHEK
Reg. Patent Attorney — Professional Engineer
1234 Broadway (31 St.) NEW YORK
Phone: Longacre 5-3088

ENGINEERS, CONSTRUCTORS—FINANCING, REORGANIZATION, DESIGN, CONSTRUCTION of INDUSTRIALS and PUBLIC UTILITIES
SANDERSON & PORTER
Chicago • New York • San Francisco

Power Plants, Structures, Transmission Systems—Design, Supervision, Inspection, Appraisals, Reports.
SARGENT & LUNDY
140 S. Dearborn St., Chicago, Ill.

Power Plants, Public Utilities, Industrial Plants
WESTCOTT & MAPES, Inc.
Architects and Engineers
New Haven, Conn.

RATE Announcements under this heading in MECHANICAL ENGINEERING are inserted at the flat rate of $1.25 a line per issue, $1.00 a line to A.S.M.E members, minimum charge, three line basis. Uniform style set-up. Copy must be in hand not later than the 10th of the month preceding date of publication.

Changes in Norma-Hoffmann Sales Organization

Norma-Hoffmann Bearings Corp., Stamford, Conn., announces a recent adjustment in the Home Office sales executive personnel, consequent upon the resignation of Carl W. Hedler as Western Sales Manager and Manager of Distributors' Sales. In line with the firm's established policy, which fosters the advancement of personnel from within its own organization, the following appointments became effective July 1st, 1945: R. L. Miller, Sales Manager; E. M. Beers, Jr., Assistant Sales Manager; G. V. Titsworth, Assistant Sales Manager; C. L. Brown, Jr., Assistant to the Sales Manager; and W. G. Sargent, Manager of Distributors' Sales. The foregoing sales executives will continue to report to Frederick W. Mesinger, Vice-President in Charge of Sales.

Lincoln Distributors Open New Office

Announcement of a new office at 211 State Street, Bridgeport, Conn., has been made by Alfred B. King & Co., distributors of Lincoln arc welders and welding supplies for The Lincoln Electric Co., Cleveland, Ohio.

Establishment of the new office was effected to render more efficient service to the large number of customers in Fairfield County, according to officials of A. B. King & Company, whose main office is located at New Haven.

Mr. Howard Pennington will be in charge of the new office.

Homestead Valve Appointments

Upon recommendation of Messrs. W. R. and F. E. Schuchman, President and General Manager, respectively, of Homestead Valve Manufacturing Co., Coraopolis, Pa., the Company's Board of Directors has authorized the appointment of Don H. Krey as Sales Manager, and Elliott G. Johnson as Assistant Sales Manager.

Mr. Krey will direct all phases of the Company's sales efforts including Valves, Hypressure Jenny Steam Cleaners, and Hypressure Jenny Compound Sales and Research; while Mr. Johnson will supervise all valve sales activities in addition to retaining his duties as Director of Advertising and Public Relations.

• LATEST CATALOGS

New Pocket Manual on Rivets

A new pocket manual, D-45, giving at a glance a general picture of what Cherry Rivets are and can do, has just been issued by the Cherry Rivet Co. of Los Angeles. This 20-page booklet, fully illustrated in three colors, covers the several basic types, their installation methods and applications.

Self-plugging and hollow Cherry Rivets in various styles, sizes and alloys are described

• Keep Informed

in detail. Of particular interest is the comparison between "blind riveting" and "pull riveting."

Typical applications in such materials as sheet metal, fabric, plywood, plastic, rubber, leather and enamels are listed, together with interesting facts about riveting thin sheet metal assemblies, fairings, sub-assembly jig work, tubes.

A section titled "A Cherry Rivet for Every Job" lists twenty types of Cherry Rivets designed for a variety of materials and uses. Application guns G-15RB pneumatic and the hand guns, G-10, G-25, G-35 and G-20 are described and illustrated, with angle adapters, flat face nippers and Cherry Rivet Kits.

Copies of the booklet will be mailed on request. Write to Cherry Rivet Co., 231 Winston St., Los Angeles 13, Calif.

Comprehensive Directory of Products Issued by Allis-Chalmers

The Allis-Chalmers Mfg. Co. announces a comprehensive directory of products and engineering literature describing the lines of equipment it furnishes to nearly every industry.

Major portion of the directory is devoted to a listing of more than 1600 product types. New Products added since the previous directory, such as induction and dielectric heating equipment, are indicated by a star for easy identification.

Engineering literature is arranged according to product discussed with new bulletins also starred. The bulletins offered in this section of the directory are written by engineers who are outstanding authorities in their respective fields. In most cases the literature contains operating data, charts, formulas, and technical information of value to the man who specifies and buys equipment.

A business reply card is included for use as a bulletin order blank, and the location of domestic and foreign sales offices is also given.

Copies of the directory of products and engineering literature are available by request from Allis-Chalmers Mfg. Co. 565, Milwaukee 1, Wisconsin.

Hays Instruments and Controls in Industry

A handsome new booklet has just been released by the Hays Corp., Michigan City, Ind., manufacturers of Combustion instruments and control, entitled "Hays Instruments and Controllers in Industry." It features schematic drawings of typical applications of instruments and controllers to the following industrial control problems: pressure reducing, pressure relief or back pressure, rate of flow, turbine-driven compressor control, and control of speed, liquid level and liquid density. The various instruments and controllers applicable to these problems are illustrated and described in detail. A copy of the publication (Bulletin 45–713) will be sent to anyone interested in the Automatic Control of industrial processes. Address The Hays Corp., Michigan City, Ind.

Aluminum Castings

Written to provide designing engineers, production executives and metallurgists with reliable information on permanent-mold-castings, a new Reference Data Bulletin PMC 45 has recently been published by The Permold Co., Medina, Ohio.

This 20-page two-color review of permanent-mold-castings points out advantages obtainable with aluminum castings with respect to such matters as cost, design and strength. Suggestions are offered to the

Continued on Page 48

Keep down Production Costs with

Tight Valves ON AIR, STEAM, AND WATER LINES

Efficient Lubrication OF BEARINGS

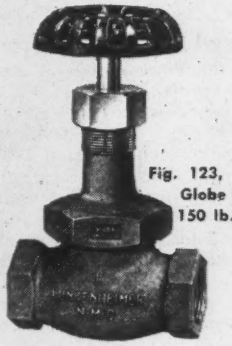


Fig. 123, "N-M-D" Globe Valve 150 lb. S. P.

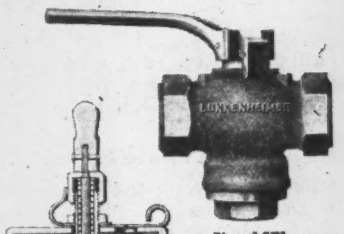


Fig. 1571 Air Cock 150 lb. Pressure

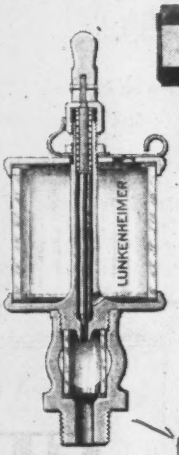


Fig. 1300 "Sentinel" Oil Cup with Sight Feed

Fig. 1815 Bottle Oiler

Fig. 1834 "Alvor" Constant Level Oil Control

Leaky valves, permitting the escape of steam, air, or water, are wasteful in themselves—doubly wasteful in their effect on production costs and operating efficiency.

Inadequate, hand-method lubrication is another cost booster . . . increasing expense of machinery repair, of lubricant, of inspection time.

And—ultimately—*both* leaky valves and inefficient lubrication mean a *waste of fuel.*

Lunkenheimer Valves and Air Cocks have a rugged durability and simplicity of design that makes them *stay tight* with the very minimum of maintenance . . . Lunkenheimer Automatic Oilers feed the right amount of oil, in the right way, at the right time, to the right place . . . These and other Lunkenheimer products are famous for their outstanding performance record.

The Lunkenheimer Co., Cincinnati 14, Ohio, U.S.A. (Branch Offices: New York 13, Chicago 6, Boston 10, Philadelphia 7. Export Department: 318-322 Hudson St., New York 13, N.Y.)

A Lunkenheimer Distributor is located near you, fully equipped to assist with your maintenance and operation problems. Call on him.

LUNKENHEIMER VALVES & LUBRICATING DEVICES